MANAGING PERCEPTIONS OF INFORMATION OVERLOAD IN COMPUTER-MEDIATED COMMUNICATION

A Dissertation

by

CHUN-YING CHEN

Submitted to the Office of Graduate Studies of
Texas A&M University
in partial fulfillment of the requirements for the degree of

DOCTOR OF PHILOSOPHY

December 2003

Major Subject: Educational Psychology

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ABSTRACT

Managing Perceptions of Information Overload in Computer-Mediated Communication.

(December 2003)

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Many studies report information overload (IO) as one of the main problems students encounter in computer-mediated communication (CMC). To date, researchers have paid little attention to the problem of IO—more specifically, to its impact on students' quality interaction—in educational CMC. In an attempt to fill that gap, the purposes of this study were as follows: (a) to understand the difficulties students encounter that contribute to their perceptions of IO in CMC, (b) to observe the impact of those difficulties on students' learning in online discussions, and (c) to identify students' strategies for avoiding or managing those difficulties in order to engage in quality learning. Interviews with students and computer conferencing transcripts were analyzed both qualitatively and quantitatively.

Interviews with 10 graduate students near the beginning of the semester revealed that although students were exposed to the same amount of information in the same learning environments, different individuals experienced different degrees of IO. Varied learner characteristics caused some students to be more susceptible to IO than others. The difficulties students encountered that contributed to their perceptions of IO included

connection problems, navigation difficulties, discomfort with online communication, numerous ongoing discussion messages and endless resources, difficulty in organizing learning, and problems understanding the assigned readings. Those difficulties tended not to affect students' deep processing as observed in their discussion messages, but might influence students' online interaction with others.

Students engaging in quality learning in online discussions were interviewed near the end of the semester to investigate their learning strategies. The results indicated that students used a variety of strategies to deal with those difficulties. Those strategies were related to online class preparation, identifying relevant information, processing online information and printed materials, keeping learning on track, organizing learning, and avoiding internal and external distractions. The results of this study have implications for course design.

Dedicated to

My parents

and

My fiancé – Kuo-Min

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I would like to thank those individuals whose help made this study possible.

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TABLE OF CONTENTS

Page

ABSTRACT…… iii

DEDICATION…… v

ACKNOWLEDGMENTS…….. vi

TABLE OF CONTENTS……..... vii

LIST OF FIGURES……. xi

LIST OF TABLES…….. xii

CHAPTER

I INTRODUCTION……... 1

Statement of the Problem……..… 4
Statement of the Purpose…….. 5
Research Questions…….. 5
Significance of the Study……. 6
Definitions…… 6
Assumptions……. 8

II LITERATURE REVIEW……. 10

Computer-Mediated Communication in Higher Education……. 10
The Growth of Educational CMC…… 10
Advantages and Disadvantages of Educational CMC……. 12
Information Overload……..... 14
Definition of Information Overload…….…… 15
Human Information Processing Model…… 17
The Impact of Information Overload on Learning……... 18
Potential Factors Contributing to Online Students' Perceptions of Information Overload....……... 21
Learner Readiness…… 21
Perceived Information Load……. 23
Quality Learning…….…….……. 27

CHAPTER Page

Deep Level of Information Processing…… 27
Interaction.....……..... 34
Learning Strategies…….. 35
Types of Learning Strategies……... 36
Learning Strategies for Dealing with Information Overload in CMC…… 40
Summary……..... 42

III METHODOLOGY…….. 44

Research Design…….. 44
Sampling……. 45
Online Courses…… 46
Interviewees…….…… 49
Human-Subjects Protection……. 50
Data Sources…… 52
Background Questionnaire…….. 52
Semi-Structured Interviews……. 54
Observations of Online Discussions…… 55
Procedures…… 56
Phase I……. 57
Phase II…… 57
Phase III……... 58
Data Analysis…….. 59
Background Questionnaire…….. 59
Semi-Structured Interviews……. 62
Observations of Online Discussions…… 65
Trustworthiness…… 75
Credibility…… 75
Transferability…….…… 76
Dependability and Confirmability…….…….. 77
Limitations…….. 79
Summary……. 80

IV RESULTS…… 81

Overview of Interviewees' Reported Readiness and Perceived Information Load……..…… 81
Class A…….. 84
Class B…….. 89

CHAPTER Page

Difficulties Contributing to Perceptions of Information Overload in CMC…… 94
Connection Problems……... 95
Navigation Difficulties…..……... 96
Discomfort with Online Communication…… 98
Numerous Ongoing Discussion Messages and Endless Resources……. 100
Difficulty in Organizing Learning…… 101
Problem Understanding the Assigned Readings……. 101
Proposed Model of Online Students' Perceptions of Information Overload…….. 102
Levels of Information Processing…….……... 105
Online Interaction…… 109
Learning Strategies to Engage in Quality Learning……. 117
Online Class Preparation Strategies……..…….. 119
Strategies to Identify Relevant Information…… 121
Strategies to Process Online Information…..…….. 125
Strategies to Process Printed Materials…..……. 128
Strategies to Keep Learning on Track……. 130
Strategies to Organize Learning ……. 131
Strategies to Avoid Internal and External Distractions……... 133
Summary……. 138

V SUMMARY, DISCUSSION, AND CONCLUSIONS……... 139

Summary and Discussion…… 139
Issues Related to Students' Readiness for Online Courses……. 140
Issues Related to Medium Interface…… 141
Issues Related to Different Learning Style Preferences and Adaptation……... 144
Issues Related to Information Selection…….. 145
Issues Related to Time Management……... 147
Factors That Affect Online Students' Deep Processing…….. 148
Factors That Affect Online Students' Interaction…… 150
The Importance of Metacognitive Strategies to Online Students… 151
Implications for Course Design……... 153
Readiness for Online Courses……. 153
Design Issues for the Course Website……. 154
Design Issues for Online Discussions…….. 156
Recommendations for Future Research……... 157

Page

REFERENCES…… 160

APPENDIX A: IRB APPROVAL LETTER…….…….. 176

APPENDIX B: AUDIO TAPE RELEASE FORM……. 177

APPENDIX C: BACKGROUND QUESTIONNAIRE…….. 178

APPENDIX D: INTERVIEW PROTOCOL I……. 183

APPENDIX E: INTERVIEW PROTOCOL II…… 184

APPENDIX F: SCHEDULING AND DURATION OF INTERVIEWS…… 186

VITA…… 187

LIST OF FIGURES

FIGURE Page

1 The Effects of Information Overload on Students' Cognition…… 19

2 Procedures……..……. 57

3 Proposed Model of Online Students' Perceptions of Information Overload…….. 104

4 Distribution of Messages Presenting Different Examples of Surface Processing…… 107

LIST OF TABLES

TABLE		Page
1	Overview of Interviewees' Characteristics..……...…….	51
2	An Analytical Framework for Conferencing Transcripts: Surface or Deep Information Processing……...	67
3	A Sample Matrix Using Mock Data to Display Interaction Patterns….....	74
4	Summary of Interviewees' Reported Readiness and Perceived Information Load……..……	83
5	Interviewees' Depth of Processing Ratios……...	106
6	Interaction Patterns Exhibited by Each Interviewee in Class A……..	111
7	Interaction Patterns Exhibited by Each Interviewee in Class B……...	113
8	Number of Times Each Interaction Pattern Was Exhibited by Interviewees…….	116
9	Overview of Interviewees' Interaction Patterns and Depth of Processing Ratios……...	118
10	Learning Strategies to Succeed in Your Online Course…..……..	135

CHAPTER I

INTRODUCTION

In this age of information, the importance of advanced education is undeniable. Over the next 20 years, the number of college students is expected to increase much faster than campuses can find space to accommodate them (Simonson, Smaldino, Albright, & Zvacek, 2000). Meanwhile, student demographics have changed, and the definitions of and differences between traditional and non-traditional students have become fuzzy (Odin, 1997). Most students today have multiple commitments and must strive to be successful both at school and at work. Consequently, increasing numbers of students enroll in online education to earn their degrees or credentials. In turn, higher education has become increasingly driven by technology in order to satisfy students' needs. Learning environments that function independent of time and place—such as those created through computer-mediated communication (CMC)—fulfill these needs by providing students the flexibility and convenience of participating in classes from any place at any time.

In CMC, instructors deliver courses entirely via the Web, and online discussions occur in a computer conferencing system. Usually the course website consists of self-instructional learning materials and ongoing interaction and communications between the instructor and students take place in computer conferencing. While the

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This dissertation follows the style and format of *American Educational Research Journal*.

instructor posts relevant resources on the Web for the class, students access and manipulate information deemed relevant to the learning goals of the course. This process, which demands their cognitive engagement through self-interaction with course content to engender learning, empowers students to be active learners. Learning can also occur in computer conferencing, which is often acknowledged as a conversation medium for knowledge construction from a constructivist perspective (Jonassen, Davidson, Collins, Campbell, & Haag, 1995). On the surface, online discussions provide an opportunity for the instructor to see students' participation in the class. Practically, students' knowledge construction can occur in online discussions through interaction with peers or the instructor. Through discussion and interaction with others, students share their experiences, explore multiple perspectives, and negotiate conflicts. This process requires students to adjust and augment prior subject knowledge and results in individual and social knowledge construction (Bannan-Ritland, 2002).

Constructivist conceptions of learning assume that knowledge is individually constructed and socially co-constructed by students based on their interpretation of experiences and prior knowledge structures (Jonassen, 1999). Knowledge construction is achieved by the interaction that takes place within oneself in the form of an internal dialogue (i.e., reflective thought) and by the interaction that occurs in communications and collaboration with other people (Vygotsky, 1962) in online discussions. CMC therefore can promote quality learning, which occurs through deep reflective thinking and interaction with others (Bannan-Ritland, 2002; Berge, 2002; Moore, 2002).

Though CMC can support teaching and learning by making information and communication easily accessible via computer networks, one of the main problems caused by CMC is information overload (IO) (Burge, 1994; Eastmond, 1994; Grint, 1989; Harasim, 1987; Paulo, 1999; Stathakos & Davie, 2000). IO becomes a problem when students simultaneously face having to acquire the technical skills necessary to participate in CMC and having to manage a large volume of information both on the course website and through computer conferencing (Berge & Collins, 1995; Harasim).

The problem of IO is also known as "cognitive overload." "Information load" is theoretically synonymous with "cognitive load" because both refer to the same theory that emphasizes constraints on human working memory. Some studies conducted in classroom settings have used the term "information load" (Fournier, 1996; Hodges, 1982; Johnson & Thomas, 1992; McClain, 1985), whereas others have used the term "cognitive load" (Sweller, 1994; Sweller, Merrienboer, & Paas, 1998). Studies conducted in hypertext environments have used the term "cognitive load" to refer to the cognitive demands of different navigation systems (Conklin, 1987; Hedberg, Harper, & Brown, 1993; Perkins, 1991). The focus of this study is IO in educational CMC; therefore, all possible factors contributing to students' perceived IO while learning were investigated. These factors included the amount of information (Baker, 1986; Bawden, Holtham, & Courtney, 1999; Noyes & Thomas, 1995; Wilson, 1995); the complexity or difficulties inherent in the learning materials (Sweller); and technological and navigation problems occurring in the CMC environment (Paulo, 1999). Considering the variety of factors contributing to IO (Fournier), there is no single generally accepted definition of

IO (Bawden et al.). For the purpose of this study, IO is defined as the point at which the capacity of students' working memory is exceeded and excessive information and stimuli from the CMC learning environment interfere with the cognitive processes required for knowledge construction.

Statement of the Problem

This study responds to a need for in-depth investigation into the phenomenon of IO. To date, very little research has examined the effects of IO in educational CMC (Burge 1994; Davie, 1996; Harasim, 1987). IO is a complex problem and means different things to different people (Burge; Fournier, 1996; Rudd & Rudd, 1986; Wilson, 1995). IO does not affect every student, and there are many possibilities for why IO occurs (Paulo, 1999). Who is more likely to encounter IO and why? What makes an individual perceive IO?

A paradox exists: whereas CMC is regarded as a powerful medium for engendering quality learning (Bannan-Ritland, 2002; Berge, 2002; Moore, 2002), this learning environment also presents problems such as IO that disadvantage learning. Theoretically, IO can cause dysfunction in students' cognitive processes and, in so doing, can reduce students' ability to make sense of learning materials and discussion messages. When students have difficulty understanding information, will they still be able to engage in deep reflective thinking? When having difficulty processing peers' messages, will students still engage in learning through interaction with others? Simply put, does IO tend to affect quality learning (defined as learning that is achievable by reflective thinking through a combination of deep-level information processing and active learning

through interaction with others)?

Not everyone encounters the difficulties that create the perception of IO. Some may have learned how to deal with those difficulties and enjoy learning in CMC. This study investigated the impact of those difficulties on students' levels of information processing and on their interaction with others in online discussions. It also aimed to identify students' strategies for avoiding or managing those difficulties in order to engage in quality learning.

Statement of the Purpose

The purposes of this study were as follows: (a) to understand the difficulties students encounter that contribute to their perceptions of IO in CMC, (b) to observe the impact of those difficulties on students' levels of information processing and interaction with others in online discussions, and (c) to identify students' strategies for avoiding or managing those difficulties in order to engage in quality learning.

Research Questions

Four questions helped to guide this research:

1. When they learn through the medium of CMC, what difficulties do students experience that contribute to their perceptions of information overload?
2. Do those difficulties affect students' levels of information processing (surface or deep processing) as observed in their discussion messages?
3. Do those difficulties affect students' interaction with others in online discussions?
4. What strategies do students employ to avoid or manage those difficulties in order to engage in quality learning (defined as learning that is achievable by deep reflective

thinking and interaction with others)?

Significance of the Study

The findings of this study will inform instructors and students of the potential problems of IO and of learning strategies for avoiding or managing IO. The answer to question 1 will offer instructors suggestions about ways they might use course design to manage students' IO in an online environment. The answers to questions 2 and 3 will help instructors identify students who are experiencing difficulties related to IO due to their participation and interaction in online discussions. Accordingly, the instructors will be able to offer adequate pedagogical support to alleviate those difficulties. The answer to question 4 will offer instructors suggestions about teaching students relevant learning strategies. It will also offer students suggestions on how to use those strategies to engage in quality learning.

Definitions

Cognitive overload is defined in the same way as "information overload."

Computer-mediated communication refers to the use of telecommunication technologies such as electronic mail, real-time chat, computer conferencing, and online databases to support human communication between spatially separated learners (Jonassen et al., 1995).

Computer conferencing involves direct human-to-human communication, with the computer providing only storage and retrieval functions. Computer conferencing uses tools such as electronic mail, bulletin board systems, and conference management systems or groupware (Santoro, 1997). It is supported by systems such as Forum,

Participate, Cosy, VaxNotes, Blackboard, Lotus Notes, FirstClass, WWWBoard, and WebCT.

Information overload occurs when the capacity of students' working memory is exceeded, and excessive information and stimuli from the CMC learning environment interfere with the cognitive processes required for knowledge construction. Hence, this concept may also be known as "cognitive overload."

Learning orientation is defined as "the aims, expectations, and attitudes with which students embark upon a new course of study" (Taylor, Morgan, & Gibbs, 1981, p. 56).

Learning strategies refer to behaviors and thoughts that a learner engages in during learning. Those behaviors and thoughts are intended to influence the learner's encoding process, namely information selection, acquisition, construction, and integration (Weinstein & Mayer, 1986).

Learning style refers to the preference that an individual may have for processing information in a particular way when approaching learning tasks (Valley, 1997). The Dunn and Dunn Learning Styles Model identified five categories according to individual differences in learners: environmental, emotional, sociological, physiological, and psychological (Jonassen & Grabowski, 1993).

Online courses refer to courses that use CMC as the primary environment for course activities. Some face-to-face meetings may be offered for specific purposes such as CMC training and introduction of the curriculum (Harasim, Hiltz, Teles, & Turoff, 1995).

Online discussions refer to asynchronous class discussions (consisting of individual postings) that occur in computer conferencing. Online discussions simulate traditional classroom discussions.

Study approach is defined as the interaction between learning styles and learning strategies (Biggs, 1988a). Biggs noted, “Styles are stable ways of approaching tasks that are characteristic of individuals, while strategies are ways of handling particular tasks: styles are focused on the person, strategies on the task” (p. 185). He further explained that the term “approach” refers to “the learning processes that emerge from students’ perceptions of the academic task, as influenced by their personal characteristics” (p. 185).

Threaded discussions refer to a non-linear format of online discussions in which each topic is the starting point for a branch of responses. Threaded discussions may be sorted by topic, date, or author. A linear format, on the other hand, does not allow branching; all postings are simply stored in a single, chronologically ordered list (Hewitt, 2001). Both FirstClass and WWWBoard computer conferencing systems offer the non-linear function of threaded discussions.

Assumptions

There were three assumptions made while conducting this study. First, because the data sources were primarily self-reports and interviews, I assumed that the participants responded frankly. Second, the interviews were carried out in front of a computer where the participants had access to the course website and computer conferencing; as a result, the effects of distortion or memory loss were assumed to be

minimal. Third, the participants were assumed to be able to respond thoughtfully throughout the semester as this study was conducted.

CHAPTER II

REVIEW OF LITERATURE

This chapter provides an overview of literature in the areas relevant to the present study and consists of five sections. The first section provides a brief history of CMC in higher education and summarizes its advantages and disadvantages. The second section introduces the phenomenon of IO and its impact on learning. The third section identifies potential factors contributing to students' perceptions of IO in educational CMC. The fourth section reviews literature related to quality learning. Quality learning is defined as learning that is achievable both by reflective thinking through a deep level of information processing and by active learning through interaction with other people. Factors influencing deep-level processing and interaction with others are also discussed. The last section introduces learning strategies in general and discusses learning strategies students use in dealing with IO in CMC in particular.

Computer-Mediated Communication in Higher Education

CMC has grown rapidly since the 1980s (Harasim, 1990) and has become pervasive due to its recognized value in teaching and learning. However, there are tradeoffs involved in using this medium. In this section, the growth of educational CMC in higher education, its advantages, and its disadvantages are addressed.

The Growth of Educational CMC

CMC was invented and implemented by Murray Turoff for commercial purposes in 1970 (Hiltz & Turoff, 1978). It was first used for instructional purposes in the early 1980s (Harasim, 1990). Distance education opportunities have grown rapidly through

the use of CMC. Both credit and noncredit courses have been offered via CMC since the mid-1980s (Simonson et al., 2000). The first educational uses of CMC were for noncredit mini-courses and for classroom-based courses in higher education (Harasim). Today, CMC courses have been successfully adopted at all levels of education (Harasim).

Higher education offers three modes of CMC: (a) adjunct mode, (b) mixed mode, and (c) online mode (Harasim et al., 1995). In adjunct mode, CMC serves as a supplement or adjunct to regular instruction. In mixed mode, a significant portion of a face-to-face or distance class is conducted by e-mail or computer conferencing. In online mode, CMC serves as the primary environment for course activities. Face-to-face meetings may be offered for specific purposes such as for technology training, for introducing the course syllabi, or for students to get to know one another.

There are well-known institutions offering online courses via CMC. Examples of institutions dedicated to distance learning include the following: the British Open University, and Fern Universität of Germany in Europe; Nova Southeastern University, and the University of Phoenix in the United States (Simonson et al., 2000); and Athabasca University in Canada. Examples of mixed-mode institutions include the following: University of Twente in the Netherlands (Simonson et al.); Ontario Institute for Studies in Education at the University of Toronto in Canada; and Deakin University in Australia.

CMC is still rapidly changing and developing and has various forms. A simple form of CMC is text-based with few graphics and consists of a computer conferencing

system and a course website. The most advanced educational CMC environments apply multimedia and hypermedia developments, incorporating graphics, audio, and video. Due to inexpensive access and fast speed, text-based CMC continues to grow at the grassroots level (Romiszowski & Ravitz, 1997).

Advantages and Disadvantages of Educational CMC

The advantages of CMC are well documented in the literature. Several scholars have recognized that CMC can offer more effective pedagogical tools for active, reflective, and collaborative learning than traditional education (Berge, 2002; Harasim, 1990; Moore, 2002). CMC has the capability not only to replicate the typical classroom teaching model with one-way lectures and demonstrations to students, but also to provide learning materials via computer networks and offer interactive technologies to facilitate positive learning experiences (e.g., active, reflective, and collaborative learning) in an "extended classroom model" (Jonassen et al., 1995). The use of CMC to communicate, exchange information, and construct knowledge is fundamental in constructivism (Jonassen, 1999). Constructivism assumes that individuals construct knowledge in context, based on the interpretation of experiences and prior knowledge (Jonassen). The two most prominent approaches in the constructivist paradigm are personal constructivism (Piaget, 1970; Von Glasersfeld, 1989) and social constructivism (Brown, Collins, & Duguid, 1989; Kuhn, 1996; Lave & Wenger, 1991; Vygotsky, 1978). Personal constructivism refers to individual knowledge construction, whereas social constructivism refers to knowledge construction occurring in communities through social interactions. Cobb (1994) argues that the two approaches (individual and social

constructivism) cannot be separated because each complements the other.

The online instructor can design the CMC learning environment to promote both personal and social knowledge construction through independent and interactive learning activities. Independent learning activities that involve self-interaction with subject matter in learner-determined instructional sequences and that are free of time constraints promote reflective thinking. Reflective thinking can also be achieved when the content of the discussions is preserved in computer conferencing so that students can easily revisit messages and reflect on them longer before posting responses (Hara, Bonk, & Angeli, 2000; Harasim, 1990). Collaborative learning through interaction with others requires learners to engage actively in idea exchange and meaning negotiation by looking at and reflecting on the multiple perspectives of fellow students. A number of researchers have acknowledged the potential of CMC to support the development of high-level reasoning skills and deep thinking (Moore, 2002). CMC's capacity for developing deep thinking depends on providing long periods of learner-controlled reflection time, interactivity through continual discussions, active cognitive engagement, and an effective collaborative group environment (Moore).

Although there are many benefits to using CMC in teaching and learning, some disadvantages have been recognized. Harasim's (1987) research using two graduate courses taught through CMC is viewed as the most telling regarding how students perceive this medium (Romiszowski & Ravitz, 1997). The disadvantages those students mentioned were IO, asynchronicity, difficulty in keeping up with online discussions, a lack of visual cues, inconvenient access, and health concerns related to computer

radiation. In Burge's (1994) study of how adult students learn in CMC, students reported that the environment possessed the following weaknesses: a high volume of information and discussion fragmentation, which contribute to students' perceptions of IO; a lack of visual and aural cues in peer interaction; and timing problems (specifically delays), which affect information processing and management. Eastmond's (1994) investigation of adult students' perspectives on distance study by computer conferencing identified IO to be one of the characteristics of the online conference. Grint (1989) found that students were overloaded with trivial messages before they were able to contribute, and that they found it difficult to carry out conversations asynchronously. Scollon (1981) found that students in a course with an enrollment of 60 were easily confused by the excessive and scattered ongoing communications and indicated that the voluminous communications were difficult to process. Hill and Hannafin (1997), examining strategies used by adult learners when learning via the World Wide Web, noted that learners perceived disorientation when they were not aware of how to locate desired information. The perceived disorientation imposed a cognitive load on the learner and affected individual search decisions. All of these studies associated the problem of IO with CMC.

Information Overload

The problem of IO is complex and has been defined variously in the literature. This section addresses a definition of IO that is derived from literature in the fields of education and CMC and is designed to fit the purpose of the present study. Additionally, the human information processing model is described in order to understand the fundamental impact of IO on students' cognitive processes.

Definition of Information Overload

Various definitions of IO were reviewed in the fields of education and CMC in order to draw a definition of IO in the educational CMC context. Research conducted in traditional classroom settings to investigate the problem of IO offered similar definitions of IO but used the term ‘information load’ and ‘cognitive load’ interchangeably. Fournier (1996) surveyed 120 college students enrolled in a technology education course about the issues of information anxiety and overload. He defined IO as a condition resulting from the amount of information exceeding the capacity of an individual’s working memory. This condition can occur anywhere along the information-processing continuum from information attention to storage to retrieval.

Some scholars defined IO in a similar manner and provided suggestions for managing classroom IO in theoretical papers (Hodges, 1982; Johnson & Thomas, 1992; McClain, 1985). Hodges made the following suggestions to instructors: do not provide too much new material; give students constant brief reminders; introduce new material at a slower pace; stimulate knowledge construction by linking new material to examples and previously known material; teach students about working memory; and increase students’ memory capacity by organizing information into unified chunks. Johnson and Thomas made the following suggestions: use external memory aids such as concept maps; use advance organizers to complement students’ inadequate prior knowledge; and help students to visualize the teaching by modeling. McClain offered suggestions for preventing overload in his discussion of how to teach a programming language. The rule of thumb is that conceptual information is needed only if it supports a task, isolates the

information of concepts and tasks, and then integrates them into the course with tasks being the focus (McClain).

Whereas the previously mentioned scholars use the term “information load,” Sweller et al. (1998) use the term “cognitive load.” Both terms refer to the load imposed on students’ working memory while learning. Sweller et al. proposed a cognitive load theory that sees working memory constraints as the primary impediment to knowledge construction. Based on this theory, Sweller et al. developed seven instructional design techniques to reduce cognitive load in traditional classroom instruction. Those effective instructional techniques include the goal-free effect, the worked example effect, the completion problem effect, the split-attention effect, the modality effect, the redundancy effect, and the variability effect. Sweller et al. conducted a series of empirical studies to test extensively the effectiveness of these techniques.

Scholars studying CMC have offered somewhat different observations regarding IO. Hiltz and Turoff (1985) found that IO occurs in organizational CMC under two conditions: (a) when individuals encounter more communications than they can respond to, and (b) when incoming messages are not sufficiently organized, resulting in users being unable to recognize the relevance of topics. Burge (1994) observed that two factors account for IO in educational CMC: (a) fragmentation of incoming information to be processed within time limits, and (b) feelings of pressure to contribute to online discussions. Paulo (1999) conducted a study to investigate the problem of real versus perceived IO. He discovered that students (a total of 25 graduate students) in the CMC component did not receive more real information than those in the face-to-face

component, in spite of their perceptions. He discussed variables inherent in the CMC environment that confounded students' perceptions of IO. Students felt that CMC required more effort than face-to-face meetings, offered too much stimulation for students to attend to and process at one time, and provided more irrelevant information (Paulo).

Drawn from the literature on both classroom instruction and CMC, IO in educational CMC has been defined here as the point when students' capacity of working memory is exceeded, and the excessive information and stimulus from the CMC learning environment interfere with their learning, i.e., knowledge construction. The following section introduces the human information processing model. This model provides a basis for understanding how IO interferes with the cognitive processes—attention, storage, and retrieval—required for knowledge construction.

Human Information Processing Model

Lindsay and Norman's (1972) work on human information processing provides a model that links directly with the ways people learn. Human memory consists of three distinct types of memory: a sensory memory, a working memory (also called short-term memory), and a long-term memory. The information processing model describes how humans process information to construct knowledge.

Sensory memory. Humans receive incoming information (i.e., input) from visual or auditory channels. Then, the information is stored in sensory memory. Sensory memory is extremely fleeting, so humans must pay attention. By attending to a particular piece of information in sensory memory, humans are able to transfer that information to

working memory. Information that is not attended to is lost.

Working memory. After receiving input from sensory memory, humans do some conscious mental work in working memory. Working memory has limited capacity and duration. Its capacity limitation is that, at most, seven elements of information can be processed simultaneously (Miller, 1956). Information in the working memory decays within about 10 seconds, unless it is rehearsed (Murdock, 1961). If the capacity of this memory is exceeded while processing information, some information will be lost.

Long-term memory. After information is processed in working memory, humans transfer that information to long-term memory for storage. Long-term memory is a large permanent store where humans' accumulated knowledge is located. This knowledge can be retrieved later on demand. Finally, humans output information.

These three processes of attention, storage, and retrieval occurring in the three types of memory are cognitive processes. Humans have a control unit. This unit is responsible for guiding and monitoring the cognitive processes. The term of metacognitive processes refers to humans' conscious use of the control unit.

The Impact of Information Overload on Learning

Learning involves linking new information in working memory to existing knowledge in long-term memory to make the new information meaningful (Weinstein & Mayer, 1986). When cognitive and metacognitive processes function well for certain purposes, humans achieve learning, i.e., they construct knowledge successfully.

IO has effects on students' cognition. According to information processing theory, the human cognitive processes include the following: attention, storage, and retrieval. IO

may occur in any of the cognitive processes (Fournier, 1996). First, when IO occurs in the attention process, students cannot attend to new information, resulting in a loss of information. Second, when IO occurs in the storage process, students cannot transfer information from working memory into long-term memory. As a result, they cannot remember that information. Third, when IO occurs in the retrieval process, students cannot activate relevant prior knowledge to working memory and thus cannot connect new information to prior knowledge. Finally, dysfunction in any of the cognitive processes results in the failure of knowledge construction. Figure 1 summarizes the effects of IO on students' cognition. The "X" mark in the figure indicates that the particular cognitive process cannot function when IO occurs in that process.

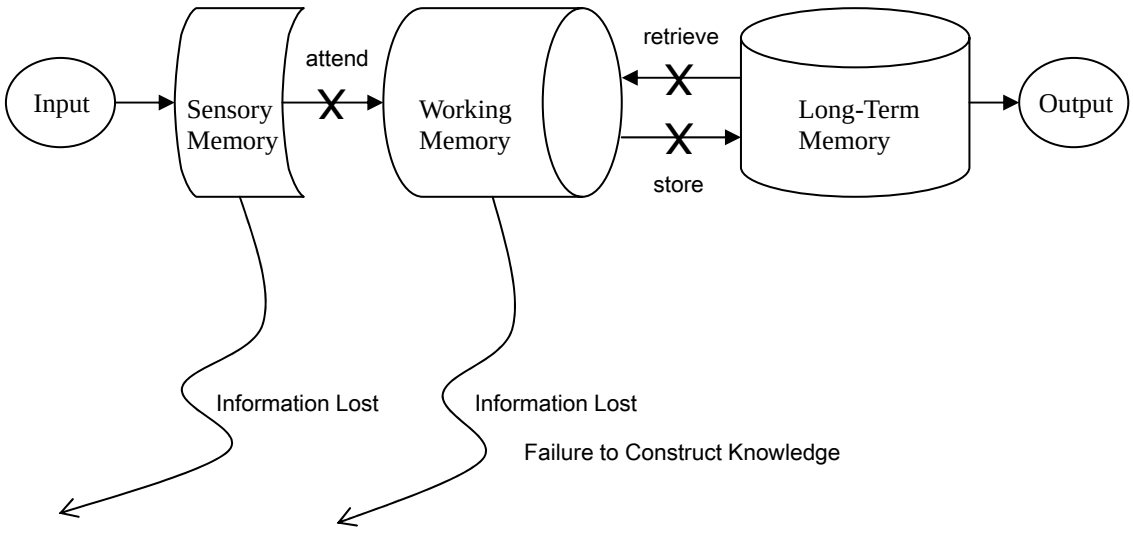


Figure 1. **The Effects of Information Overload on Students' Cognition**

A number of studies or conceptual articles in educational CMC literature have revealed the consequences of IO on students' learning. Online students with IO may drop a course or participate less or late in online discussions (Eastmond, 1994), may detract from the development of rational and serious discussion (Grint, 1989), or may not be able to keep up with online discussions (Burge, 1994; Harasim, 1987). IO may prevent students from interacting actively with their classmates (Stathakos & Davie, 2000; Vrasidas & McIsaac, 1999), or may reduce students' ability to process information at a deep level (Angeli, Valanides, & Bonk; 2003).

Angeli et al. (2003) designed course instruction that combined the power of asynchronous computer conferencing and case-based reasoning to promote the critical thinking skills of 146 undergraduate students (who were pre-service teachers). Each student in this class was required to post a teaching case that was observed in the field, post messages regarding at least four other cases written up by peers, and summarize the electronic discussion generated for a peer's case during a six-week session. The results indicated that students' online discourse was extremely conversational and opinionated, and showed little evidence of critical thinking. The researchers suspected that the following factors might influence students' lack of deep thinking: a lack of strategies for assessing other students' online contributions, undergraduate students' tendency of thinking less critically, discussion facilitators' moderating strategies, and an overwhelming number of messages.

Psychological symptoms associated with IO include feeling overwhelmed or lost

(Bawden et al., 1999); frustrated (Harasim, 1987); stressed (Burge, 1994; Hiltz & Turoff, 1985); and anxious, confused, or depressed (Fournier, 1996). It is speculated that the stress caused by IO can reduce a person's information processing productivity and accuracy (Eisenberg & Small, 1993).

In summary, when IO occurs, people's cognitive processes can be affected and emotional problems can emerge, resulting in impaired learning. The next section discusses the potential factors contributing to IO among online learners.

Potential Factors Contributing to Online Students' Perceptions of Information Overload

A review of the literature on information technology and science, communication, psychology, and education identified elements likely to contribute to students' IO in educational CMC. The review revealed two categories of potential factors: learner readiness and perceived information load. Factors related to limited learner readiness are a lack of the technical skills for participating in CMC, a lack of prior subject knowledge, and a lack of English reading/writing proficiency. Factors influencing perceived information load are the quantity of information, the quality of information, and the medium interface.

Learner Readiness

Three factors that limit learner readiness and are likely to lead to students' perceptions of IO are as follows: (a) a lack of the technical skills for participating in CMC, (b) a lack of prior subject knowledge, and (c) a lack of English reading/writing proficiency. Students who lack any of the above knowledge/skills are more likely to be at risk of IO.

Lack of the technical skills for participating in CMC. Students lacking the technical skills needed to participate in CMC may be more susceptible to IO (Paulo, 1999). They have to possess computer skills to gain access to online systems and to use relevant software to accomplish course requirements. They also need computer conferencing skills in order to perform CMC tasks such as participating in online discussions and interacting with fellow students and instructors online. Consequently, students who lack such skills may spend more time and mental effort learning to use the technology and developing conferencing skills than they spend on mastering the subject content (Stathakos & Davie, 2000). Hillman, Willis, and Gunawardena (1994) have identified this factor as a learner-interface problem. They argued that students have to be able to interact with the technology and manipulate interfaces in order for learner-teacher, learner-content, and learner-learner interactions (Moore, 1989) to occur successfully.

Lack of prior subject knowledge. A lack of prior subject knowledge refers to the lack of existing knowledge in long-term memory related to the new content domain in which students are going to learn. The more prior subject knowledge students have, the greater the capacity their working memories have to process new information (Sweller et al., 1998).

Lack of English reading/writing proficiency. The ability to read and write well is necessary in the text-based CMC environment (Eastmond, 1995). Students with inadequate language proficiency may suffer reduced processing ability if the capacity in their working memory is used up in coping with the tasks of reading and writing in English. This factor particularly affects non-native speakers whose first language is not

English. Non-native English speakers are at a severe disadvantage according to research in first-language and second-language writing, which indicates salient differences between the two in terms of both composing processes and texts produced (Angelova & Riazantseva, 1999). Flowerdew and Miller's (1995) study investigating lecture discourse structure noted that some non-native English speakers were often not aware of the key prompts in lecture content. The prompts are key words or phrases, or topic sentences, usually found at the beginning of a paragraph in English writing. Those prompts activate specific schemata that students will need to process information. If textual materials are not structured in a similar fashion in their native language, students may have difficulty processing the passages.

Tu (2001) offered a vivid description of how exhausting it is for Chinese students to read and compose a message in an online class: students often print their online discussion messages on paper, read and analyze the messages, write responses in Chinese on paper, and translate the responses into English, referring to the English-Chinese dictionary when needed. Translation of the responses into English requires a selection of Chinese words and phrases that could be translated into English, yet certain Chinese words had no English equivalent. This time-consuming process disadvantages Chinese students' online communication.

Perceived Information Load

Students' perceived information load stems from three areas: the quantity of information, the quality of information, and the medium interface. If the quantitative and qualitative components of information, and the cognitive demand of the medium

interface exceed the capacity of a person's working memory, IO may occur.

Quantity of information. Quantity of information is the traditional source of IO, i.e., a person is presented with too much information to be processed within limited time (Wilson, 1995). Large volumes of information accumulate through computer conferencing messages and the proliferation of online databases. In computer conferencing, active discussions generate heavy amounts of reading for each participant, and this problem grows with the group size (Harasim, 1990). The workload is heavier when students must follow both the online discussions and other course readings (Harasim). In addition, the proliferation of online databases demands that students possess information management skills, particularly when the instructor provides rich resources on the course website in addition to the large numbers of resources available on the Internet. Students often experience IO when they treat the resources with equal priority or have trouble distinguishing what is most relevant to their learning goals (McCormack & Jones, 1998).

Quality of information. Certain qualitative components of information help explain obstacles to processing information. They include: (a) difficult learning materials, (b) text ambiguities, and (c) redundant information. Difficult learning materials reflecting the inherent complexity of course content impose a load on students' working memory (Sweller et al., 1998).

Text ambiguities cause students to misinterpret information. According to media richness theory, text communication is a lean medium. It lacks the social cues—such as facial expressions, body language, and intonation—that aid participants' clarification and

understanding of discussions (Trevino, Lengel, & Daft, 1987). Students may experience text ambiguities while reading information on the course website, course materials, and conferencing messages.

Redundant information refers to repetitive, irrelevant, or trivial information. Repetition of ideas may occur naturally in asynchronous communication because there is no need for turn-taking (Mason & Kaye, 1990). For instance, while one is composing a message in computer conferencing, other students may be writing the same thing at the same time (Burge, 1994).

Medium interface. The interfaces of computer conferencing and online databases are different. Yet, both can contribute to difficulties in processing information. The threading structure of messages and multiple conference spaces in computer conferencing and the hypertext structure of online databases on the Web contribute to fragmentary information and navigation problems (Fastrez, 2000; Harasim, 1990; Hiltz & Turoff, 1985; Murphy, Drabier, & Epps, 1998).

In computer conferencing, a user interface that makes it awkward to navigate through discussion threads contributes to message fragmentation. That fragmentary information, in turn, influences students' knowledge construction. Students have trouble following the line of discussion because messages do not flow in a linear order, and they express seemingly disparate ideas. Harasim (1990) proposed three processes of knowledge construction that occur when individuals learn through computer conferencing: idea generating, idea linking, and idea structuring. Current computer conferencing systems support idea generating (e.g., composing a message). However,

there are few tools to support idea linking (e.g., putting all messages belonging to one topic thread into a logical and linear order) and idea structuring (e.g., weaving messages belonging to different topic threads into a coherent whole) (Harasim). Further, multiple conference spaces can confuse students and cause them to reply to the wrong conferences (Hiltz & Turoff, 1985).

The proliferation of online databases on the Web and their hypertext structure leads to learner disorientation and cognitive overload (Conklin, 1987; Hill & Hannafin, 1997). Conklin defined disorientation as users not knowing where they are within hypertext documents and not knowing how to move to the desired location. This phenomenon is commonly known as “lost in hyperspace.” He defined cognitive overload as a load imposed on users when they navigate through the hypertext. While reading through each web page, users must constantly make choices about which links to follow and which to abandon. Users may become overwhelmed and distracted by large numbers of links.

Users with inadequate prior subject knowledge are more likely to encounter navigation problems when browsing content-domain relevant Web resources (Carmel, Crawford, & Chen, 1992). The researchers found that domain experts and novices employed different browsing strategies in a hypertext system. Experts were interested in more specific topics and usually read the most information about a chosen topic. Novices navigated along more referential links than experts did and changed topics more frequently while browsing.

However, navigation problems seem inevitable. It has been shown consistently

that even skilled readers of print experience navigation problems while browsing hypertext systems (Edwards & Hardman, 1989).

The aforementioned IO studies explained the potential impact of IO on learning and various potential factors contributing to students' IO. The next section is devoted to issues related to the quality of learning experiences and factors influencing it, including IO.

Quality Learning

CMC is acknowledged for its capabilities of promoting reflective thinking and active learning, both of which are necessary to carry out quality learning. This section reviews literature related to quality learning (defined as learning that is achievable by reflective thinking through a deep level of information processing and by active learning through interaction with other people). Factors influencing deep-level processing and interaction with others are also discussed.

Deep Level of Information Processing

Knowledge construction can be achieved through learner self-interaction with to-be-learned materials based on the individual's experience or prior subject knowledge; i.e., reflective thinking (Vygotsky, 1962). Reflective thinking requires deep-level processing to engender the quality of outcome in learning.

Factors that may influence levels of information processing include students' study approaches, affective dimension, learning orientation, and the amount of mental effort that students put into studying. Studies showed that a deep approach, an absence of anxiety, intrinsic motivation, and more mental effort contribute to a deep level of

information processing.

Numerous studies (Biggs, 1978; Entwistle & Waterston, 1988; Marton & Säljö, 1976; Pask, 1976) have focused on the student's depth of information (or cognitive) processing, specifically describing a deep-surface dimension. Researchers focusing on this deep-surface dimension, which permits classification of a student's approach to learning, have attempted to ascertain how it relates to academic performance. For example, using qualitative methods to identify the ways that traditional university students learn, Marton and Säljö initially identified two different levels of processing: surface-level and deep-level processing. In the case of surface-level processing, "the student directs his attention towards learning the text itself (the sign), i.e., he has a reproductive conception of learning which means that he is more or less forced to keep to a rote-learning strategy" (p. 7). On the other hand, in the case of deep-level processing, the student is "directed towards the intentional content of the learning material (what is signified), i.e., he is directed towards comprehending what the author wants to say about, for instance, a certain scientific problem or principle" (p. 7–8). Deep-level processing has a high correlation with the quality of outcome in learning (Marton & Säljö).

Marton and Säljö (1984) identified two approaches to studying from printed texts in relation to levels of information processing: a surface approach and a deep approach. A surface approach refers to instances when students approach learning texts in a fairly superficial way, employing rote strategies in order to reproduce what they think is required by the course or the instructor. On the other hand, students who exhibit deep approaches actively look for relationships among new ideas within the given new

information, and link new information to their existing knowledge. Their goal is to assess critically the relevance of the given information to their own experience in order to achieve meaningful learning (Marton & Säljö).

Differences in terms of their affective dimension and learning orientation among students who adopt either deep or surface approach were identified. In general, a student who adopts a deep approach has an interest in the academic task, and a focus on theorizing about the task at hand and its relationship to previous knowledge (Anderson, 2001). In contrast, a student who adopts a surface approach sees the task as a demand to be met, relies on rote learning, and concentrates on discrete components of the task unrelated to other tasks (Anderson). Entwistle and Waterston's (1988) investigation of the relationships between university students' studying orientation and levels of processing found the following:

- Surface-level processing has a high correlation with a reproducing orientation (a surface approach and fear of failure).
- Deep-level processing is closely related to a meaning orientation (a deep approach and intrinsic motivation).

Earlier research found that anxiety and extrinsic motivation are correlated with a surface approach, whereas intrinsic motivation and an absence of anxiety are correlated with a deep approach (Fransson, 1977). Darke's (1988) research with college students also showed that high levels of anxiety decrease the storage and processing capacity of working memory.

Taylor et al. (1981) differentiated between intrinsic and extrinsic motivation in

their investigation of distance students' learning orientations. They defined orientation as "the aims, expectations, and attitudes with which students embark upon a new course of study" (p. 56). They identified four types of orientation: vocational, academic, personal, and social. Vocational refers to learners' concerns with getting a job in the future; academic refers to learners' concerns with continuing education; personal refers to personal development; and social refers to their enjoying the freedom of university life. Intrinsic motivation is related to students' concerns with the relevance of a course to their future career, intellectual development, and self-improvement. Extrinsic motivation is related to their concerns with obtaining the qualifications needed to achieve a promotion at work, getting good grades and degrees, passing the course, and having a good time in sport and social activities. The findings of Taylor et al. are consistent with those of other researchers (Entwistle & Waterston, 1988; Fransson, 1977), who concluded that students with intrinsic motivation were more likely to adopt deep approaches to study and had more meaningful learning.

However, the relationship between deep approaches and academic performance is equivocal (Anderson, 2001; Biggs, 1988b). Some studies have reported positive relationships (Biggs, 1979; Marton & Säljö, 1984; Schmeck & Phillips, 1982), whereas others have failed to find any (Busato, Prins, Elshout, & Hamaker, 1998; Watkins, 1983).

When the medium of content presentation is hypertext, it is still uncertain that whether a deep or a surface approach is superior (Beishuizen, Stoutjesdijk, & van Putten, 1994). In a series of empirical studies that observed students' study behaviors in a hypertext environment, Beishuizen et al. concluded that deep processors are not always

superior to surface processors and that study skills are amenable to instruction. Deep processors and surface processors, as defined by Beishuizen et al., are students with different study habits or learning styles. According to these scholars, in a hypertext environment, deep processors tend to explore topics in depth and structure searching paths according to their own needs or interests. In contrast, surface processors tend to search broadly and explore many or all of the topics, and thus have much less clear transitions when searching. Surface processors are inclined to work step by step, whereas deep processors tend to start from the overall perspective of key topics in order to maintain an overview of the domain; deep processors also search in depth to gain insight.

Due to the differences in terms of studying orientation and approaches between deep processors and surface processors, Beishuizen et al. (1994) concluded that surface processors easily feel disorientated in the hypertext environment, whereas deep processors are used to looking for structure themselves. Surface processors need the offered linear structure of complex and unknown domains to arrive at the same level of task accomplishment as deep processors do spontaneously. As Beishuizen et al. also point out, deep processors without sufficient prior knowledge may suffer from their tendency to delve too deeply into a topic of interest because no internal, knowledge-based criteria are available to separate relevant from irrelevant information. This claim seems to parallel the findings of Carmel et al. (1992) regarding the different browsing strategies employed by domain experts and novices in a hypertext system. Deep processors lacking prior knowledge need the instructional support such as an

advance organizer that surface processors do in order to regulate their reading behaviors.

The amount of invested mental effort also determines the levels of information processing. More mental effort results in deeper processing of information (Horton & Mills, 1984; Salomon, 1983). Salomon defined the amount of invested mental effort as the number of nonautomatic elaborations applied to a unit of material. As defined, this construct reflects both cognitive and motivational attributes (Salomon). Nonautomatic effort demands cognitive elaborations. Motivation is probably the driving force for the expenditure of effort, but it is the effort-demanding activities that produce better recall, comprehension, and inference-making (Salomon).

According to Salomon (1983), the amount of mental effort invested in processing information provided by a medium or a task depends on two types of perceptions: perceived demand characteristics (i.e., the perception of how demanding the medium or the task is) and perceived self-efficacy (i.e., the perception of one's capability of obtaining information from that medium or performing that task). The amount of mental effort invested in a medium or a task is determined by the interaction between perceived demand characteristics and perceived self-efficacy:

- An individual with high perceived self-efficacy will not invest much mental effort unless that person perceives the demands of the medium or the task to be high.
- An individual with low perceived self-efficacy will invest mental effort only if that person perceives the demands of the medium or the task to be low.

For example, Salomon (1984) assumed that children regard television as an easy (less

demanding) medium compared to books and that they perceive their capability of learning from television as high compared to their capability of learning from books. Therefore, children are expected to invest less mental effort when learning from television programs than from books. Salomon's study proved his hypothesis by showing that information from television was less deeply processed than information from books. As expected, children felt more efficacious with television, and perceived it as more realistic and easy. Books were reported by children to demand more effort, but led to better inference making.

Motivation is highly related to deep approaches and is suggested to be a potential factor in students investing more mental effort in their studies. In distance education, students' characteristics—such as motivation, prior online learning experiences, cognitive abilities, and learning styles—have an impact on their success (i.e., completion of a course) (Simonson et al., 2000). Motivation has been suggested as one major difference between distance learners and traditional classroom learners (Office of Technology Assessment, 1989). Distance learners should be highly motivated to take on the responsibilities of learning and invest the amount of time and effort necessary to accomplish the learning goals. Research studies have identified three predictors of probable completion of a distance education course: intention to complete the course, early submission of work, and completion of other distance education courses (Armstrong, Toebe, & Watson, 1985; Billings, 1988; Moore & Kearsley, 1996). Those factors can help identify students who may not be motivated to complete a course (Cornell & Martin, 1997).

In summary, the literature indicated that IO can reduce people's ability to process information, hinder knowledge construction, and cause anxiety, thereby resulting in surface-level processing. However, not only IO and anxiety determine levels of information processing. Other elements such as motivation, the amount of invested mental effort, and study approaches also play a crucial role in influencing deep processing. Next section reviewed literature relevant to interaction, which is another important component contributing to quality learning.

Interaction

Knowledge construction can also be achieved by active learning through interaction with other people (Vygotsky, 1962). Vrasidas and McIsaac (1999) defined interaction as "the process consisting of the reciprocal actions of two or more actors within a given context" (p. 25), i.e., learner-learner and learner-teacher interactions.

Interaction is regarded as a critical component of the educational process (Berge, 2002). Bates (1995) noted that if a major rationale for CMC is to encourage and develop the skills of academic discourse, active participation from all students is important; however, it can be argued that in a face-to-face teaching environment, many students do not participate actively, yet often learn. It is also not clear from research that interaction improves the quality of learning in most distance education programs (Kearsley, 1995). Nevertheless, interaction may lead to learner satisfaction, which in turn contributes to motivation. Cheng, Lehman, and Armstrong (1991) reported a higher completion rate for those online learners who worked collaboratively (90%) than for those who worked independently (22%) in computer conferencing classes. In their teletraining instruction,

Martin and Bramble (1996) found that students typically preferred to interact with the instructor, fellow students, and the instructional media by asking questions and having discussions rather than to listen to a lecture or have limited involvement and interaction.

Vrasidas and McIsaac (1999) conducted a study through qualitative approaches to examine factors influencing interaction in an online graduate course. They found that besides IO (stemming from factors including students' perceived demands of the amount of coursework and inexperience with CMC), the structure of the course and feedback also influenced interaction. Some elements of the course structure, such as required activities, led to more interactions. Other aspects of the course structure, such as a combination of face-to-face and online meetings, led to fewer interactions because students viewed the online meetings as a break rather than an opportunity to engage in online discussion. On the issue of feedback, students indicated that they felt discouraged from interacting when they did not receive adequate feedback from either the teacher or their peers.

Whereas research indicates that study approaches may affect students' quality of learning, the next section is devoted to addressing techniques that students use during learning. The section also reviews literature that discusses strategies students use to deal with IO.

Learning Strategies

This section consists of two parts: types of learning strategies, and learning strategies for dealing with information overload in CMC. The former introduces learning strategies in general. The latter describes learning strategies students use in dealing with

IO in the CMC environment in particular.

Types of Learning Strategies

Literature in the field of psychology offers many methods of categorizing learning strategies (Olgren, 1998; Tessmer & Jonassen, 1988; Weinstein & Mayer, 1986). In general, learning strategies can be collapsed into three broad categories: cognitive strategies, metacognitive strategies (Olgren; Weinstein & Mayer), and affective strategies (Weinstein & Mayer).

Cognitive strategies. Cognitive strategies encompass selection strategies, rehearsal strategies, elaboration strategies, and organizational strategies (Olgren, 1998; Weinstein & Mayer, 1986). These strategies aim at assisting learners cognitive processes to construct knowledge and facilitate later recall.

Students use selection strategies such as external and internal focusing to direct their attention and to differentiate relevant from irrelevant information (Olgren, 1998). External focusing refers to students identifying important information based on external means such as learning objectives, overviews/outlines provided in the course, and course requirements. Internal focusing is based on students' own needs, goals, and interests (Olgren). Selection strategies are necessary because the human information processing system has a limited processing capacity. The ability to select incoming information is of paramount importance for successful studying (Beishuizen et al., 1994).

Students use rehearsal strategies to help them remember what they learn. Examples include repeating, reading aloud, reviewing, copying, or underlining only the important parts of a lesson. Rehearsal strategies are usually regarded as rote learning

strategies because students memorize information by simple repetition or reproduction. Understanding can enhance the ability to remember learning materials (Olgren, 1998).

Elaboration and organizational strategies that aim at understanding play an important role in deep and effective learning. Elaboration strategies help students understand new information. Students then link the new information to their prior knowledge. Visualizing, associating, summarizing, creating metaphors, and paraphrasing are common examples of elaboration strategies (Olgren, 1998; Weinstein & Mayer, 1986).

Organizational strategies help students understand and remember the given information by translating it into another form and building connections within the information given. Students use organizational strategies to divide information into different groups based on shared attributes and to indicate the relationship among those groups (Weinstein & Mayer, 1986). Classifying, diagramming, comparing, contrasting, and creating a concept map, a hierarchy, or an outline are common examples of organizational strategies. Whereas elaboration and organizational strategies are regarded as deep approaches, rehearsal strategies are regarded as surface approaches (Olgren, 1998).

Metacognitive strategies. Metacognitive strategies assist students in guiding and monitoring their cognitive processes. Scholars indicated that “being aware of one’s own cognitive and affective states, and controlling and monitoring one’s own cognitive processes, are the defining attributes of metacognition” (Brown, Bransford, Ferrara, & Campione, as cited in Biggs, 1988a, p. 187).

Metacognition refers to an individual's awareness, knowledge, and control of cognitive processes (Derry & Murphy, 1986). Awareness means that the student is aware of the learning tasks and of what is required to achieve the tasks. Knowledge indicates that the student possesses the knowledge pertinent to achieving the learning tasks. Control refers to the student's ability and tendencies to plan and regulate cognitive processes.

There are two types of metacognitive strategies—orienting and regulating strategies (Olgren, 1998). Orienting strategies include identifying required tasks, appraising the relevance or usefulness of the tasks, estimating the mental effort involved, establishing goals, and making a study plan to prepare for learning. A common example of these techniques is students' preparation for learning by using the instructor's syllabus for information about course objectives, expectations, and requirements.

Regulating strategies are used to monitor cognitive processes. Checking comprehension, monitoring time and pacing, adapting cognitive strategies to learning demands, revising goals, persisting until tasks are completed, seeking help, and self-testing to evaluate what was learned are common examples of regulating strategies. Metacognitive strategies are directed at regulating the cognitive and affective strategies and therefore indirectly lead to learning results (Vermunt, 1996).

In an investigation of the ways university students learn, Vermunt (1996) identified two types of learners according to their regulating styles: externally-regulated learners and self-regulated learners. Externally-regulated learners rely on the external means supplied by instruction to govern their learning process, whereas self-regulated

learners rely on internal resources. Externally-regulated learners let themselves be directed by the regulation sources offered by instruction or the instructors, such as introductions, learning objectives, directions for studying, questions, assignments and self-tests (Vermunt). In contrast, self-regulated learners let themselves be guided by questions that they ask during studying; they try to find answers; they also consult literature related to the course topics to deepen their interests, to understand the subject matter better, or to get a broader view on it; and they adapt their study approach especially to their personal interests, prior knowledge, and the requirements that in their view are posed by different courses (Vermunt). Self-regulated learners display high self-efficacy, self-attribution, and intrinsic task interest (Anderson, 2001). Vermunt's findings further showed that students who are mostly self-regulated tend to display deep processing.

There is a relationship between students' study approaches and regulating styles. Beishuizen et al. (1994) found that students who combine self-regulation with deep processing and students who combine external regulation with surface processing outperform students with a mismatch between processing and regulation style. They indicated that deep processors generally prefer self-regulation over external regulation; even when clear external means are provided, they tend to follow their own rules of selection. Beishuizen et al. further noted that surface processors are more inclined than deep processors to profit from instructional support at the cognitive level such as an advance organizer.

Whereas the relationship between study approaches and academic performance is

controversial, research findings concerning the relationship of metacognition to academic performance seem more consistent: metacognitive strategies lead to improvements in academic performance. Bernt and Bugbee (1993) reviewed the studies relating metacognition specifically to performance in distance education courses and concluded that distance students often failed to monitor their progress and their comprehension of material. This lack of metacognition led to an ineffective use of time and resulted in poor performance. Biggs (1988b) suggested that increasing metacognitive awareness led to better performance outcomes. Everson and Tobias (1998) showed the positive relationship between high metacognitive abilities and course grades. Kurtz and Weinert (1989) demonstrated that metacognition was a better predictor of performance than either scores on traditional intelligence tests or effort attributions.

Affective strategies. Affective strategies are used to create and maintain an individual's emotional status and a suitable environment for learning. They include strategies that students use to focus attention, maintain concentration, manage anxiety, establish and maintain motivation, and manage time effectively (Weinstein & Mayer, 1986). Examples of affective strategies are using relaxation and positive self-talk to reduce anxiety, reducing environmental distractions by finding a quiet place to study, establishing priorities, and setting a schedule. Affective strategies may be the most effective for information selection and acquisition (Weinstein & Mayer).

Learning Strategies for Dealing with Information Overload in CMC

Several studies have found that when IO occurs, people consciously or subconsciously adopt different strategies to cope with it in different circumstances.

Bettman (1979) indicated that consumers fight IO by limiting their potential purchasing options to a more manageable number of choices using strategies such as focusing their attention more narrowly, using past experience to eliminate one or more groups of choices, or simply ignoring a great deal of information. Miller (1960) found that when IO occurs, people naturally utilize adjustment mechanisms such as temporary non-processing of information, processing incorrect information, delaying processing, selecting some kinds of information while ignoring others, and escaping from the task. Fournier (1996) found that students in classroom situations in which IO occurs adopt coping strategies such as taking lots of notes, asking questions, mentally pausing and reflecting, mentally shutting down in the face of incoming information, and just ignoring information that does not make sense and hoping to catch up later.

Educational CMC studies (Burge, 1994; Eastmond, 1994; Harasim, 1987) examining the strategies students use when learning online identified the following strategies for dealing with IO: selection, organizational, and metacognitive strategies. Selection strategies include filtering out unwanted information and keeping what appears to be useful information, scanning on-screen messages in one attention period, focusing on the assigned topics by ignoring irrelevant ongoing conversations, and reading and commenting selectively. Organizational strategies include keywording ideas in messages and producing a paper transcript. Metacognitive strategies include keeping up with the discussion, organizing time more efficiently, establishing study goals for each time period, and encouraging peers to write shorter messages.

Literature in the fields of information technology and science identified

elaboration and organizational strategies that help manage or reduce IO by using technology. These strategies include categorizing messages in computer conferencing and establishing a personal homepage. Message categorization encourages students to define a set of categories and then create related folders to manage incoming messages for online discussions or electronic mailboxes (Gerosa, Fuks, & DeLucena, 2001). The personal homepage solution is offered for managing information from the Internet and suggests that students create and customize a homepage to display and update materials in which they are interested (Anupam, Breitbart, Freire, & Kumar, 1999; Khan & Card, 1997).

Summary

This review of literature was organized into five sections: (a) CMC in higher education, (b) IO, (c) potential factors contributing to online students' perceptions of IO in CMC, (d) quality learning, and (e) learning strategies. The first section presented the background information necessary to understand CMC learning environments in higher education. CMC learning environments not only offer advantages but also have limitations. IO is one of those limitations and is a problem mentioned in most CMC literature. In the second section, a definition of IO was drawn from the literature for the purposes of this study. Additionally, the human information processing model was described in order to understand the impact of IO on the cognitive processes required for knowledge construction. In the third section, potential factors contributing to online students' perceptions of IO were identified from the relevant CMC literature. The fourth section reviewed literature related to quality learning (defined as learning that is

achievable by reflective thinking through a deep level of information processing and by active learning through interaction with other people). Factors influencing deep-level processing and interaction with others were also discussed. The last section introduced learning strategies in general and discussed learning strategies students use in dealing with IO in CMC in particular. The next chapter describes the methodology used to accomplish the purposes of this study.

CHAPTER III

METHODOLOGY

This study was conducted in order to: (a) understand the difficulties students encounter that contribute to their perceptions of IO in CMC, (b) observe the impact of those difficulties on students' levels of information processing and interaction with others in online discussions, and (c) identify students' strategies for avoiding or managing those difficulties in order to engage in quality learning. This chapter describes the methods used to accomplish the purposes of the study.

Research Design

This study employed a mixed-method design, combining both qualitative and quantitative approaches to collect, analyze, and report findings (Creswell, 2002). The dominant paradigm was naturalistic; only a small component of the study made use of quantitative data.

The naturalistic paradigm was a logical choice for the present study because it provided students with the opportunity to express their individual feelings and experiences. It also allowed me to construct and interpret the meaning of their experiences in order to reach a thorough understanding of the phenomenon of IO. The participants in this study were graduate students in online classes. These students were mostly non-traditional (i.e., part-time students, many of whom were employed full-time). They entered the online classes with diverse backgrounds, characteristics, and learning experiences. Moreover, the online classes were designed and developed by different instructional designers and educators and were implemented and delivered using

different software and applications. Due to the diversity and the idiosyncrasies of the individual students and the online classes, different individuals might have different experiences of IO and, consequently, use different strategies to deal with it. For this exploratory study conducted in natural settings, qualitative approaches were suitable. Quantitative content analysis was used in determining the potential impact of IO on students' learning in online discussions. It was particularly helpful both in confirming the findings of the literature and in verifying the qualitative findings of the interviews.

Sampling

A two-stage purposive sample was used for this study, one for selecting sample classes and another for selecting interviewees from the sample classes. In order to be chosen as one of the two sample classes, a class had to meet the following criteria: (a) it had to be a semester-long online graduate course; (b) computer conferencing had to be an integral component of course activities and had to be used to replace traditional classroom discussions; and (c) one of the course requirements had to be student participation in online discussions. Two classes that satisfied these criteria were selected at a large dual-mode university in the southwestern United States. The study participants were student volunteers from the selected classes.

A single criterion was used in selecting study participants for interviews from the sample classes: the students had to possess varying degrees of experience with online learning. The participants were divided into three different groups according to their online course experience: a group of students who had not taken any online courses before, a group of students who had taken one or two online courses previously, and a

group of students who had taken more than two online courses before. Interviewees were selected randomly from each group.

Online Courses

The two online courses chosen as samples (Class A and Class B) differed in content, but targeted a similar level of learning. Both were graduate-level courses at a college of education; and both were reading and writing intensive. Class A introduced the students to an overview of the history, theory, research, and practice of educational technology, whereas Class B introduced the students to critical issues in the field of education from an interdisciplinary perspective.

The instructional context of each class was comprised of a course website and a computer conferencing system where online discussions took place. The course website presented the course structure and provided the information the students needed to understand what was required of them to complete the course. The course-related information included overviews of the contents, course requirements such as required reading materials, descriptions of learning activities, and the grading scheme. Both classes held an orientation meeting at the beginning of the semester. Focused on introducing the syllabus and conducting technology training, this session also provided the opportunity for the instructor and students to meet face-to-face and get to know one other in a familiar setting. Class A used the desktop client version of FirstClass 6.0 for computer conferencing, whereas Class B used a version of Web Board (WWWBoard 2.03a) that was embedded into the course website. Students in Class A had online discussions and submitted assignments via FirstClass. Meanwhile, students in Class B

had online discussions via Web Board and submitted assignments via the course website. Both online learning environments were designed to take advantage of new instructional technologies in order to develop a collaborative, learner-centered approach for active and effective learning.

The learning activities offered by these two classes differed slightly. Both courses included small-group discussions, individual projects and critiques, and final papers. However, the instructors designed and implemented the small-group discussions differently. Students in Class A conducted small-group discussions entirely via FirstClass, and this component of the course accounted for 50% of their total grade. On the other hand, students in Class B conducted small-group discussions both online and on-site. Online discussions were carried out in Web Board; on-site discussions took place on campus on three Saturdays (for half the day). The discussions accounted for 40% of the total grade—20% each for online and on-site discussions. The two sample classes had slightly different requirements for the online discussions. Students in both classes had to participate in and co-facilitate discussions based on assigned readings throughout the semester. The participation required by Class A was a minimum of 5 postings for each bi-weekly unit discussion. Class A required the co-facilitators to post 3 discussion questions prior to the beginning of the unit, to moderate the discussions (typically to guide and monitor the discussions, and to stimulate participation), and to synthesize the discussions at the end of the unit. The discussion participants in Class B were not required to post a specific number of messages for each weekly unit discussion. Instead, Class B co-facilitators could post any discussion questions of interest and had to

moderate the discussions throughout the unit; a minimum of one posting was required of each co-facilitator.

The computer conferencing capabilities of FirstClass and Web Board differ. FirstClass is a professional communication tool. It provides multiple functions that foster interactive and collaborative learning: icon-based conferences that support threaded discussions on organized topics, private e-mail, file attachments with multimedia ability, real-time text-based chats (Persico & Manca, 2000), and collaborative document writing spaces. The text-based collaborative document writing spaces offer different font types, colors, and sizes in much the same way a general word processor does. The newest version of 6.0 offers an enhanced editor with paragraph formatting, an editor ruler, additional text styles, and hypertext links for both collaborative documents and message composing. The functions of spell check and message search are also included. Additionally, some effective message navigation tools are offered, including message sorting and summarizing functions.

FirstClass can be accessed either via any Web browser or by client software that is installed on each user's machine. The client version is recommended because it offers more complete functions and a faster connecting speed than the Web-based version. However, the Web-based version is more accessible than the client version. Students can log on to the Web version from any computer with Web access and can do so without having to install software or set up a special connection.

The Web Board conferencing system is Web-based and fairly easy to use. Students can post a new topic or reply to a particular message with a click of the mouse.

Message search and subscription functions are offered. This system offers branching capabilities and supports the display of multiple-level threaded discussions. The version of Web Board used by Class B supported only single board (conference) function; no multiple conference spaces were offered as FirstClass did.

Interviewees

Both classes met face-to-face in an orientation session held on the first Saturday of the semester. A questionnaire was administered during the orientation meetings in order to gather students' demographic data, survey their background knowledge (including their online course experience), and obtain their agreement to participate in the study. The two classes had a total of 21 students. Class A had 12 students; Class B had 9. A total of 18 students agreed to participate in this study: 9 females and 9 males.

For the purpose of sampling interviewees, students were divided into groups according to their experience with online courses. Eight students who had not taken any online courses before constituted one group. The 6 students who had taken one or two online courses previously formed a second group. There were 4 students who had taken more than two online courses before. They made up the third group. Of the 18 students who had agreed to participate in the study, 12 were selected at random, with the one condition that the sample consist of students representing each of the different levels of online course experience. Six of the students selected were online novices. Four had taken one or two online classes. Two had taken more than two online classes.

The background questionnaire revealed the characteristics of the interviewees (Alan, Bill, Carl, Doris, Eric, Frances, and Grace in Class A; Helen, Ivan, Jack, Kevin,

and Lily in Class B). These characteristics are summarized in Table 1. Of the 12 interviewees, 7 were males and 5 were females. Half of them were master's students and half were doctoral students. Five interviewees were full-time students, whereas 7 were employed full-time. Eight interviewees indicated that they possessed prior subject knowledge at the beginning the course, whereas 4 indicated that they did not. Nine interviewees were native English speakers whereas 3 were not. With the exception of Kevin, all interviewees indicated that their English reading and writing proficiency was at either a fluent or a good level. Students with different ranges of online course experience were selected purposefully: 5 were online novices; 5 had previously taken one or two online classes; and 2 had taken more than three online classes. Students also represented a broad range of experience with technology use: 2 were at the novice level; 4 were at the moderate level; and 6 were at the experienced level.

Human-Subjects Protection

This research involving human subjects was reviewed and approved by the Institutional Review Board (IRB) at Texas A&M University (see Appendix A for the letter of approval). At the beginning of this project, the students in both classes were informed of the purposes of the study and were asked to complete a consent form. The consent form stated that their participation was entirely voluntary and confidential. To ensure confidentiality, a first-name only pseudonym was used to protect each participant's identity. Audio-taping took place during face-to-face interviews. Interviewees signed an audiotape release form (Appendix B) to indicate their willingness or refusal to be taped.

Table 1

Overview of Interviewees' Characteristics

Student	Gender	Level of Study	Student Status	Employed	Prior Subject Knowledge	English Reading/Writing Proficiency	Online Experience (# classes taken)	Technology Use Experience
Class A								
Alan	Male	Master's	Part-Time	Full-Time	Yes	Fluent/Fluent	3^{+}	Experienced
*Bill	Male	Master's	Full-Time	Part-Time	Yes	Good/Good	1–2	Moderate
Carl	Male	Master's	Part-Time	Full-Time	Yes	Fluent/Fluent	1–2	Experienced
*Doris	Female	Master's	Full-Time	No	No	Fluent/Good	0	Novice
Eric	Male	Master's	Full-Time	Part-Time	Yes	Fluent/Fluent	1–2	Experienced
Frances	Female	Master's	Part-Time	Full-Time	No	Fluent/Fluent	0	Moderate
Grace	Female	Doctoral	Part-Time	Full-Time	No	Fluent/Fluent	3^{+}	Experienced
Class B								
Helen	Female	Doctoral	Full-Time	Part-Time	Yes	Fluent/Fluent	1–2	Experienced
Ivan	Male	Doctoral	Part-Time	Full-Time	No	Fluent/Fluent	1–2	Novice
*Jack	Male	Doctoral	Full-Time	Full-Time	Yes	Fluent/Good	0	Moderate
Kevin	Male	Doctoral	Full-Time	Full-Time	Yes	Fair/Fair	0	Experienced
Lily	Female	Doctoral	Full-Time	Part-Time	Yes	Fluent/Fluent	0	Moderate

Note. * indicates a non-native English speaker.

Data Sources

Three data sources were used in the study: a questionnaire, semi-structured interviews, and observations of online discussions. This section describes these data sources and their relation to research questions.

Background Questionnaire

The background questionnaire (Appendix C) was designed to collect participants' demographic and background information. It consisted of 5 parts: (a) demographic data, (b) prior subject knowledge, (c) English reading and writing proficiency, (d) online course experience, and (e) technology use experience.

Part I of the questionnaire requested demographic data: contact information, current standing (i.e., master's- or doctoral- level student), major/department, total number of hours enrolled in this semester, and total number of hours spent per week at a job. It also included information about further participation in the study. Part II consisted of a series of open-ended questions (regarding students' undergraduate and/or graduate major and the number of relevant courses taken) designed to determine participants' prior subject knowledge. Part III was a self-report survey that asked students to rank their English reading and writing proficiency as poor, fair, good, or fluent. Part IV, an online course experience survey, inquired how many online courses participants had taken and what delivery software was used in those online courses. Part V was a technology use survey. This self-report survey asked participants to identify their level of skill for a range of tasks, including: basic computer operation, file management, file transfer, e-mail use, Web browser operation, Internet use, computer conferencing, and

information searching. This survey was adapted from Harvell's (2000) Background and Experience of Developers questionnaire, which was adapted from the Bellingham Public Schools' Staff Use of Technology: 1999–2000 Self-Evaluation Rubric (1999).

The background questionnaire employed in the present study served four purposes:

1. Sampling interviewees. Interviewees were selected according to their responses to the questions regarding online course experience. The criterion for selecting interviewees from the sample classes was students with different ranges of online course experience.
2. Establishing each participant's profile. Understanding each student profile from the beginning saved time and the need to ask routine background questions during interviews.
3. Identifying students who were at risk of IO. Students' responses to questions regarding prior subject knowledge, English proficiency, online course experience, and technology use experience were used to determine which students were at risk of IO. Those four constructs were identified from the literature as potential contributors to students' perceptions of IO. The results were eventually used to triangulate the findings from the first round of interviews.
4. Aiding thick description of interviewee characteristics. A thick description, which was used to establish transferability, was based in part on the data obtained from the questionnaire.

Semi-Structured Interviews

Two rounds of semi-structured interviews were conducted using interview protocols I and II, respectively, as guides. I tested the questions beforehand by conducting pilot interviews with two novice and two experienced online graduate students, making revisions as needed such as clarifying ambiguous texts and broadening or refining the questions in order to elicit more thorough information.

Interview protocol I. I used this instrument (Appendix D) as a guide to conduct the first round of interviews. The purpose of this round of interviews was to answer research question 1: When they learn through the medium of CMC, what difficulties do students experience that contribute to their perceptions of information overload? I also used the findings to determine the degree of difficulty interviewees experienced. Accordingly, I classified them into Low, Medium, and High IO groups.

Interview questions 1 and 2 were designed to examine those difficulties by exploring interviewees' learning experiences both in online discussions and on the course website. Interview question 3 focused on the time-management issues in organizing learning. Interview questions 1 and 2 both included one sub-question: How do those information processing issues influence your learning? This sub-question elicited the information that, in turn, helped investigate the findings to research questions 2 and 3. Several additional probing questions were prepared to identify how the quantity of information, quality of information, and interfaces of CMC contributed to interviewees' perceptions of IO. The interviewees were guided to talk about their learning experiences in the online class they were taking.

Interview protocol II. I used this instrument (Appendix E) as a guide to conduct the second round of interviews. The purpose of this round of interviews was to answer research question 4: What strategies do students employ to avoid or manage those difficulties in order to engage in quality learning (defined as learning that is achievable by deep reflective thinking and interaction with others)?

I compiled the results of the first round of interviews to identify difficulties contributing to those interviewees' perceptions of IO. In the second round of interviews, I asked each interviewee two interview questions about each difficulty. Interview question 1 was designed to explore interviewees' experiences in dealing with each difficulty. Interview question 2 was designed to explore particular aspects of this online class—such as the instructor, fellow students, and/or the instructional design strategies—that helped them deal with each difficulty.

Using interview protocol II, I interviewed those students who were able to engage in quality learning through deep reflective thinking and interaction with others. They were identified using the combined results of research questions 2 and 3; those who met the necessary criteria (i.e., the depth of processing ratio was beyond 0.70 and a pattern of two interactions or above two interactions was exhibited) for identification as students engaged in quality learning. The goal was to elicit the learning strategies they used to avoid or manage those difficulties related to IO.

Observations of Online Discussions

I observed the online discussions to answer research questions 2 and 3:

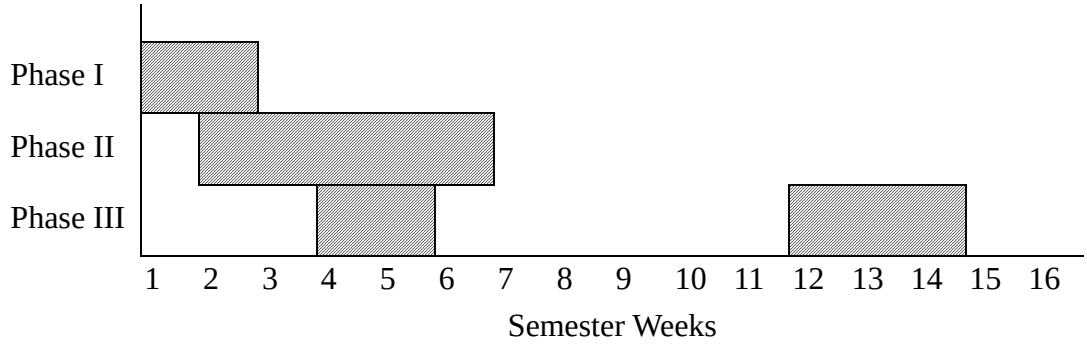
- Do those difficulties affect students' levels of information processing (surface or deep processing) as observed in their discussion messages? and
- Do those difficulties affect students' interaction with others in online discussions?

This investigation also identified students who engaged in quality learning through deep information processing and interaction with others. Those students' learning strategies were examined in order to answer the fourth research question.

The discussions carried out near the beginning of the semester—when, according to Harasim (1987), IO is more pronounced—were the focus of the analysis. I downloaded transcripts of the online discussions every week—from the third week (the beginning week of Class A discussions) or the second week (the beginning week of Class B discussions) through to the sixth week of the semester—and examined them immediately.

Procedures

The online classes examined in the present study began in January 2002 and ended in May 2002. The study was conducted in three phases over the entire semester. Phase I was conducted at the beginning of the semester. Phase II was conducted from the second week through to the sixth week of the semester. Phase III was conducted during the fourth and fifth weeks of the semester and near the end of the semester. Figure 2 provides an overview of this schedule. The specific activities of each phase of the study are described in detail below.



Note. Phase I – Collected consent forms and background questionnaires.
Phase II – Collected transcripts of online discussions.
Phase III – Conducted interviews.

Figure 2. **Procedures**

Phase I

The first class meeting—a one-day orientation session—was held on the first Saturday of the semester. During this session, students enrolled in both classes were asked to participate voluntarily in Phase I of this study and to sign the consent form. The background questionnaire was also administered, a process that took approximately 20 to 30 minutes. Based on their responses to the questionnaire and their agreement to participate further, I selected 12 students to proceed to Phase II and III of this study.

Phase II

I collected selected participants' (those who were to be interviewed) online discussion messages near the beginning of the semester because the literature indicated that IO is more pronounced early in a course, particularly during the first five weeks (Harasim, 1987). Class A began the online discussions via FirstClass computer

conferencing system at the beginning of the third week of the semester, whereas Class B began the online discussions via Web Board at the beginning of the second week. Accordingly, I collected Class A interviewees' discussion transcripts from the third week through to the sixth week and Class B interviewees' discussion transcripts from the second week through to the sixth week.

Phase III

I conducted two rounds of interviews between February and April 2002. The first round of interviews was conducted during the fourth and fifth weeks of the semester when students would be more susceptible to IO. Data analysis of the first round of interviews was finished before the second round of interviews began. The second round of interviews was guided by the analysis of data collected in the first round.

The second round of interviews was conducted near the end of the semester (during the twelfth, thirteenth, and fourteenth weeks of the semester) in order to investigate the strategies students were using to avoid or manage IO and engage in quality learning.

I conducted the interviews by e-mail, in online chat sessions, or in a face-to-face meeting, depending on what was most convenient for each participant. From my perspective, the face-to-face meeting was most desirable. Several options were offered in order to ensure saturation of information. In the first round of interviews, 3 students chose to be interviewed via FirstClass online chat and 9 students chose face-to-face interviews. In the second round of interviews, those 3 persons who had chosen to be interviewed via FirstClass in the first round chose to respond to questions via e-mail.

Those 9 individuals who had chosen face-to-face interviews in the first round chose them again for the second. Each interview ranged from 20 to 75 minutes in length. A total of 17 hours and 45 minutes of interviews was recorded and transcribed (Appendix F).

Data Analysis

This section describes how I analyzed each data source, which included the background questionnaires, the interviews, and the transcripts of online discussions. I used a combination of quantitative and qualitative approaches for analysis: the background questionnaires and the transcripts of online discussions were analyzed in a quantitative manner; the analysis of the interviews employed a qualitative approach.

Background Questionnaire

The background questionnaire (Appendix C) consisted of four parts: (I) prior subject knowledge, (II) English reading and writing proficiency, (III) online course experience, and (IV) technology use experience. The data have been summarized in Table 1. This section describes how each part was analyzed further to identify the interviewees who were at risk of IO.

The information provided in Part I was used to identify each interviewee's level of prior subject knowledge as low, medium, or high. An interviewee's level was determined using the following two criteria:

- The student's previous undergraduate or graduate major was relevant to that person's current major.
- The student had taken at least one course relevant to the current course.

Interviewees who satisfied neither of the criteria were considered to possess a low level of prior subject knowledge; a medium level if they satisfied either one; and a high level if they satisfied both.

The information provided in Part II was used to identify each interviewee's level of English reading and writing proficiency as low, medium, or high. An interviewee's level was determined using the following two criteria:

- The student was a native English speaker.
- The student indicated either fluency or possessing a good level of English reading and writing proficiency.

Interviewees who satisfied neither of the criteria were considered to possess a low level of English proficiency; a medium level if they satisfied either one; and a high level if they satisfied both.

Interviewees were ranked as novice, moderate, or experienced online learners according to information they provided in Part III regarding the number of online courses they had taken. Those interviewees who had not taken any online courses before were identified as novice online learners; those who had taken one or two online courses previously were identified as moderate online learners; and those who had taken more than two online courses before were identified as experienced.

Interviewees were ranked as novice, moderate, or experienced technology users according to the information they provided in Part IV. Interviewees were asked to assess their level of experience on a scale ranging from 1 (low) to 4 (high). Those interviewees who indicated an average level of technology use that was less than 2 were identified as

novice users; those who indicated a level of technology use that was equal to or greater than 2 (but less than 3) were identified as moderate users; those who indicated an average level of technology use that was equal to or greater than 3 were identified as experienced users.

The results of Parts III and IV were combined to identify each interviewee's level of technical skill (possession of skills needed to participate in CMC) as low, medium, or high. An interviewee's level was determined using the following criteria:

- The student was identified as a novice online learner and a novice technology user.
- The student was identified as a moderate online learner and an experienced technology user.
- The student was identified as an experienced online learner and a moderate technology user.
- The student was identified as an experienced online learner and an experienced technology user.

If interviewees satisfied the first criterion, they were considered to possess a low level of the technical skill required to participate in CMC; if they satisfied none of the criteria, they were considered to possess a medium level of the technical skill required to participate in CMC; if they satisfied 1 of the last 3 criteria, they were considered to possess a high level of the technical skill required to participate in CMC.

I identified those interviewees who were at risk of IO by combining their levels of any mentioned knowledge skills. An interviewee was identified as at risk of IO if that

person possessed a low level of either prior subject knowledge, English proficiency, or technical skill required to participate in CMC.

Semi-Structured Interviews

All transcripts were analyzed using qualitative transcripts analysis that was consistent with the constant comparative method. The constant comparative method is an inductive data analysis, which uses the specific raw data of transcripts to generate abstract categories. The analysis was not linear (step-by-step) but took the form of successive iterations involving the procedures described below. The iterations were repeated until no new patterns emerged. The analysis consisted of four essential procedures based on Lincoln and Guba's (1985) techniques of unitization and categorization:

1. Unitizing. Taking into consideration the two characteristics of a unit suggested by Lincoln and Guba, I identified the units of information that related to the research questions in the interview transcripts:

   > First, it [a unit] should be heuristic, that is, aimed at some understanding or some action that the inquirer needs to have or to take.…Second, it must be the smallest piece of information about something that can stand by itself, that is, it must be interpretable in the absence of any additional information other than a broad understanding of the context in which the inquiry is carried out (p. 345).

   A unit may be as small as a sentence or as large as a paragraph. Those indicators, or units of information, are "chunks of meaning which come out of data itself" (Marshall, 1981, p. 396). Throughout the unitizing process, units for coding, or indicators, were identified.

2. Coding. During this process, each indicator was coded by identifying and

formulating any ideas it suggested. After coding, I examined the indicators and their coding closely in order to identify preliminary categories and wrote memos next to those indicators in which I made note of relevant ideas, observations, and reflections.

3. Categorizing by comparison. Each indicator was compared to other indicators in the same category, as well as to indicators in different categories. Indicators not belonging to any existing categories emerged during this process. In this case, either new categories were created, or the existing categories were redefined to include the emergent indicators. In this manner, all indicators were grouped and regrouped into categories based on their similarities and differences.
4. Generating definitions of categories. I constantly compared indicators to indicators and categories to categories in order to eliminate redundancy and develop evidence and a definition for each category (Creswell, 2002). In the process, I was able to define emergent categories and redefine existing categories.

Half of the analysis was conducted on paper; half was carried out electronically. First, I printed out all interview transcripts and read them closely for initial unitizing, using a pencil to underline the units identified. Second, I copied each unit from the electronic files and pasted it into an Excel spreadsheet (specifically, into a single cell belonging to the column labeled “Indicators”). Third, I generated a column that I labeled “Coding” and a column that I labeled “Memos” next to the indicator column. I examined the indicators closely several times to determine their codes. During this coding process, I generated a list of codes designed to make my coding consistent and to facilitate the use of the sorting function provided by Excel. After coding, I used the sorting function to

group all indicators with the same coding together. I then created preliminary categories to identify the clusters of indicators with the same or different coding. Finally, I compared and contrasted indicators in all categories and generated definitions of categories. This dynamic and iterative process continued until the categories were well defined. I analyzed both rounds of interview transcripts in this manner. There are a number of software packages that are useful for qualitative analysis, including Atlas/ti, NUD*IST, and NVivo. The present study employed Excel. One factor in this decision was cost: I had the Excel software on hand. Unlike some of the other packages, Excel could also be accessed conveniently at any of the computer labs at the university.

The results of the first round of interviews also served to divide the students into three groups: Low IO, Medium IO, and High IO students. According to the literature, students' perceptions of IO generally stem from problems with three areas: the quantity of the information they are asked to process, the quality of information they are asked to process, and the medium interface used in the learning environment. In the present study, each interviewee's reported difficulties related to IO were classified into one or more of these areas. Depending on the number and type of difficulties an interviewee reported, the interviewee's degree of difficulty in each area (i.e., quantity of information, quality of information, and medium interface) was identified as low, medium, or high. The degree of difficulty for a given area was considered to be low if the interviewee reported no difficulties in that area; the degree of difficulty was considered to be medium if not too many difficulties were reported in that area; and it was considered high if the interviewee reported several difficulties in that area. Interviewees who were determined

to have a low degree of difficulty in all three areas were placed in the Low IO group. Those who were determined to have a high degree of difficulty with one or more of the three areas were placed in the High IO group. Other interviewees were placed in the Medium IO group.

Observations of Online Discussions

I employed a quantitative content analysis in examining the conferencing transcripts of the online discussions. I identified interviewees' levels of information processing and their interaction patterns in online discussions using the model of analysis developed by Henri (1992).

A number of models are available for the evaluation of information quality in computer conferencing. Given the varying purposes of the research studies for which they were developed, these models naturally differ from one another. However, they all tend to evaluate the same three phenomena: participation, social interactivity, and cognitive/metacognitive processes or critical thinking. Henri (1992) did pioneering work in the development of criteria for computer conference analysis based on a cognitive view of learning. Henri's model suggested five dimensions for analysis:

- students' participation rates,
- social presence within students' messages,
- cognitive skills of surface or deep processing within students' messages,
- metacognitive skills within students' messages, and
- students' interaction.

The first dimension allows for analysis of the level of participation in the form of usage statistics. The second dimension offers analysis of the social dynamics of conferencing exchanges such as the aspects of communication for participation, social cohesion within the group, and the feeling of belonging. The third dimension allows for analysis of the cognitive skills (i.e., elementary clarification, in-depth clarification, inference, judgment, and strategies) exhibited in conferencing messages along with the surface or deep level of processing. Henri suggested that it is insufficient to identify the cognitive skills at work only as they are indicated by message content. Therefore, she developed another model to evaluate the cognitive processes exhibited in conferencing messages. This model (see Table 2) identified two levels of information processing: surface processing and deep processing. Surface-level processing occurs when one:

- repeats oneself without further elaboration or adding new information,
- makes supporting comments or acknowledgements without further elaboration,
- offers information without evidence of elaboration or justification,
- asks irrelevant questions, and/or
- demonstrates fragmentary understanding.

Deep processing occurs when one:

- links facts and ideas,
- offers new information,

Table 2

An Analytical Framework for Conferencing Transcripts:

Surface or Deep Information Processing

Category	Indicators
Surface processing	1. Repeating the information contained in the statement of the problem without making inferences or offering an interpretation 2. Repeating what has been said without adding any new elements 3. Stating that one shares the ideas or opinions stated, without taking these further or adding any personal comments 4. Proposing solutions without offering explanations 5. Making judgments without offering justification 6. Asking questions which invite information not relevant to the problem or not adding to the understanding of it 7. Offering several solutions without suggesting which is most appropriate 8. Perceiving the situation in a fragmentary or short-term manner
Deep processing	1. Linking facts, ideas, and notions in order to interpret, infer, propose, and judge 2. Offering new elements of information 3. Generating new data from information collected by the use of hypotheses and inferences 4. Proposing one or more solutions with short-, medium-, or long-term justification 5. Setting out the advantages and disadvantages of a situation or solution 6. Providing proof or supporting examples 7. Making judgments supported by justification 8. Perceiving the problem within a larger perspective 9. Developing intervention strategies within a wider framework

Note. From “Computer conferencing and content analysis.” by F. Henri, 1992, In A. R. Kaye (Ed.), *Collaborative learning through computer conferencing: The Najaden papers*, p. 130. Copyright 1992 by Springer-Verlag. Adapted with permission.

- proposes solutions with justification,
- discusses the tradeoffs involved in a situation or solution,
- makes judgments supported by justification or examples, and/or
- presents a wider perspective.

The fourth dimension allows for analysis of the metacognitive processes exhibited in conferencing messages. Finally, the last dimension allows for analysis of interactivity occurred among conference participants. In this model for analyzing interactivity, Henri proposed three types of interactive process—explicit, implicit, and independent. An explicit process refers to a direct response to or a comment on a specific message or student. An implicit process refers to an indirect response or a commentary in which the content of another student's message is mentioned, but not that person's name. An independent process is a posting that stands alone without referring to any other messages or students.

Several investigators have applied Henri's (1992) model for the evaluation of online discourse (e.g., Gunawardena, Lowe, & Anderson, 1997; Hara et al., 2000; Newman, Webb, & Cochrane, 1995). Gunawardena et al. selected Henri's model as the starting point to analyze interaction of the online debate transcript. Hara et al. used this model to examine the social and cognitive processes as well as the interactivity patterns exhibited in the electronic transcripts of an online conference. The online conference was carried out in a graduate-level course. A supplemental class discussion, it employed an instructional method called the starter-wrapper technique. Hara et al. modified Henri's model, particularly the dimension of interaction, in order to understand better the

impact of the starter-wrapper technique on students' learning in computer conferencing. They indicated that coding students' metacognitive processes was difficult because it was difficult both to observe students' metacognitive processes in nature and to define them specifically. As Hara et al. explained: (a) a self-introduction might represent both cognitive skills as well as a social presence, and (b) starting a discussion or providing short message introductions might correspond with ideas of planning. Consequently, they made a similar conclusion to Henri's; whereas identifying students' cognitive processes provides only a superficial understanding of the presence and frequency of such skills in message content, identifying deep or surface level of processing provides additional valuable information.

Looking for signs of critical thinking as evidence of group and deep learning in a computer conferencing context, Newman et al. (1995) applied Henri's (1992) model of cognitive dimension and Garrison's (1992) model of critical thinking. Garrison's model was used to measure critical thinking in face-to-face and CMC learning. Newman et al. observed that Garrison's five stages of critical thinking (i.e., problem identification, definition, exploration, applicability, and integration) correspond closely to Henri's five cognitive skills (i.e., elementary clarification, in-depth clarification, inference, judgment, and strategies).

The purpose of my study was to find evidence of quality learning characterized by a deep level of information processing and interaction with others. Henri's (1992) methods of evaluating cognitive skills of surface or deep processing within students' messages and students' interaction suited this purpose. Her analytical framework for

evaluating levels of information processing was drawn from the work of Entwistle and Waterston (1988), which was reviewed in chapter 2. I found her framework for evaluating interaction to be too simple; I modified it to meet the need in the present study for judging interaction with other people. Other models for evaluating interactivity have mainly attempted to analyze the social effects of conferencing exchange (Bannan-Ritland, 2002). These effects are not the focus of the present study.

To analyze surface or deep information processing, I used Henri's (1992) model for analyzing levels of information processing (see Table 2) as the coding system. As suggested by Henri, the unit of analysis was each idea within a message (i.e., a posting). Although Henri did not offer clear criteria for the unitizing technique, other scholars (Budd, Thorp, & Donohue, 1967; Lincoln & Guba, 1985) have done so. Budd et al. offered the conventional thematic unit method and described the unit of meaning as "a single thought unit or idea unit that conveys a single item of information extracted from a segment of content" (p. 34). Lincoln and Guba presented an operational unitizing technique that was described above in the section on qualitative transcript analysis. I adopted Lincoln and Guba's working definition of a "message unit" to identify unit segments. During the unitizing process, units for coding were identified and categorized using the coding protocol (Table 2).

The content analysis consisted of a frequency count of the occurrence of each coding category in each coding unit posted by each interviewee. I did not simply count the units appearing in the surface processing and deep processing categories, which was Henri's (1992) approach. Applying Newman et al.'s (1995) approach, I also converted

each interviewee's total counts of surface and deep processing into a depth of processing ratio for the purpose of conducting a between-class comparison. A depth of processing ratio was calculated for each interviewee using the formula $(X^{+} - X^{-}) / (X^{+} + X^{-})$, converting the counts to a -1 (all surface) to +1 (all deep) scale (Newman et al.). X^{+} was used to indicate total units of deep processing, whereas X^{-} was used to indicate total units of surface processing for each interviewee. When a unit contained both deep and surface ideas, then this unit was coded as both deep processing and surface processing.

In observing interaction patterns, I used a modified version of Henri's (1992) method of evaluating interaction. Some researchers contend that simply counting those three interactive processes (i.e., explicit, implicit, or independent message) does not provide enough information to analyze properly students' interactivity in discussions (Hara et al., 2000). Hara et al. indicated that in their online conference, the interaction appeared to be much more complex (more than two participants were usually involved in each discussion). With this criticism in mind, I modified Henri's method of evaluating interaction to accommodate my need to observe students' interaction with others. In observing interviewees' interaction patterns, I incorporated Henri's idea of the three interactive processes. A message that answered the discussion question was counted as an independent process because there was no interactive process with other people or their messages. The unit of analysis was a message (i.e., a posting). By observing the combination of interactive processes exhibited by each interviewee for a particular discussion question, varied interaction patterns occurred. These interaction patterns were "no interaction," "one interaction only," "two interactions," and "above two

interactions."

- "No interaction" pattern: This pattern was defined as "0 0 *X*," where *X* refers to any number. This pattern occurred when the discussion participant exhibited no messages at all, exhibited any number of independent messages, or both.
- "One interaction" pattern: This pattern was defined as "1 0 *X*" and "0 1 *X*," where *X* refers to any number. This pattern occurred when the discussion participant posted one explicit/implicit message and/or any number of independent messages.
- "Two interactions" pattern: This pattern was defined as "2 0 *X*," "1 1 *X*," and "0 2 *X*," where *X* refers to any number. This pattern occurred when the discussion participant posted two explicit/implicit messages and/or any number of independent messages.
- "Above two interactions" pattern: Otherwise, the pattern was defined as "above two interactions." This pattern occurred when the discussion participant posted more than two explicit/implicit messages and/or any number of independent messages.

To explain by example how these coding procedures are presented, I generated mock data for 5 made-up students. This information was then displayed in Table 3, showing a distribution of each interactive process for each student (grouped by the discussion questions). There were two units in all; each unit contained two discussion questions. A total of 5 students (Don, Jessica, Daniel, Tony, and Sally) participated in the

discussions. For example, for discussion question 1 in the first unit, Don posted 1 explicit message, 0 implicit messages, and 0 independent messages, and therefore generated the “one interaction” pattern ("1 0 0"). His interaction pattern for discussion question 2 in the first unit was the “above two interactions” pattern (“3 0 1”).

After each interviewee’s interaction patterns were coded, the number of times each interaction pattern was exhibited by each interviewee was determined. Interviewees’ totals for each interaction pattern were used to determine their level of involvement with others when learning in online discussions. Due to their different participation requirements, Class A and Class B were observed separately. Class A required that each student post a minimum of 5 postings in each bi-weekly unit discussion. Students in Class B were not expected to post any specific number of messages in each weekly unit discussion, although Class B did require a minimum of one posting from each co-facilitator.

Table 3

A Sample Matrix Using Mock Data to Display Interaction Patterns

Discussion Unit	Discussion Question	Interactive Process	Student				
			Don	Jessica	Daniel	Tony	Sally
Unit 1	Q1	Explicit	1	0	2	3	2
		Implicit	0	0	0	0	1
		Independent	0	1	1	1	2
	Q2	Explicit	3	0	1	0	3
		Implicit	0	0	1	0	0
		Independent	1	0	3	1	1
Unit 2	Q1	Explicit	1	0	2	3	1
		Implicit	0	0	1	0	0
		Independent	1	1	1	1	0
	Q2	Explicit	1	0	1	1	3
		Implicit	0	0	1	0	0
		Independent	2	0	3	1	1

Note. Explicit = a direct response to or a comment on a specific message/student.
Implicit = an indirect response or comment in which the content of another student's message was mentioned, but not that person's name.
Independent = a message that stood alone without referring to any other messages/students, or a message that answered the discussion question.
"No interaction" pattern = "0 0 *X*" (*X* refers to any number).
"One interaction" pattern = "1 0 *X*," and "0 1 *X*" (*X* refers to any number).
"Two interaction" pattern = "2 0 *X*," "1 1 *X*," and "0 2 *X*" (*X* refers to any number).
"Above two interactions" pattern = patterns other than "no interaction," "one interaction," and "two interactions."

Trustworthiness

The trustworthiness of both the processes and the findings of this study were tested using four naturalistic analogues to the conventional criteria of internal and external validity, reliability, and objectivity. These analogues are termed "credibility," "transferability," "dependability," and "confirmability," respectively (Lincoln & Guba, 1985).

Credibility

Credibility refers to internal validity. Internal validity can be enhanced by establishing causal relationships and by checking for spurious relationships. In so doing, the credibility or true value of the findings is achieved. Lincoln and Guba (1985) have offered the following techniques to enhance credibility: persistent observation, triangulation, peer and expert debriefing, and member checks. I employed those techniques to achieve credibility:

1. Persistent observation. I became immersed in the context of the course by exploring the websites, conferencing structures, and syllabi of both classes. I also observed their online discussions in order to explore interviewees' learning experiences adequately.
2. Triangulation. Triangulation uses multiple and different sources and methods to achieve credibility. The sources employed in this study included: a questionnaire, documents containing the course website structures, conferencing structures, and syllabi, observations of online discussions, and interviews. The methods employed included both qualitative and quantitative approaches. Quantitative data obtained

from the questionnaire and observations of online discussions were used to support and verify the qualitative findings obtained in the interviews.

3. Peer and expert debriefing. I discussed and explained my views and interpretations of the study results with two uninvolved peers to keep from being distorted by hearing different perspectives. I also reported the preliminary findings to my co-chairs and asked for suggestions for improvement.
4. Member checks. I gave a brief report of findings to the interviewees and requested feedback. This feedback allowed me both to refine and to ensure the validity of the results.

Transferability

Transferability refers to establishing external validity; i.e., determining the extent to which the findings of the study can be generalized. It is strictly impossible for naturalistic researchers to generalize their findings; however, they can provide the thick description required by someone interested in determining whether transferability is possible (Lincoln & Guba, 1985). The inquirer should provide "a sufficient base to permit a person contemplating application in another receiving setting to make the needed comparisons of similarity" (p. 360). In other words, it is the inquirer's responsibility to provide a knowledge base that is sufficient for rendering transferability judgments (Lincoln & Guba). I have attempted to meet that requirement in this study. A thick description of interviewees' characteristics was achieved based on the data obtained from the background questionnaire. A thick description of the context of the

course was achieved based on the information related to the course website and the conferencing structure, and the syllabi.

Dependability and Confirmability

Dependability and confirmability refer to reliability and objectivity; the former refers to the potential for replication of the study with similar subjects in a similar context whereas the latter refers to "the extent to which the data and interpretations of the study are grounded in events rather than the inquirer's personal constructions" (Lincoln & Guba, 1985, p. 324). In this study, an inquiry audit was conducted of the qualitative transcript analysis. An inter-rater reliability process was applied to the quantitative content analysis.

Lincoln and Guba (1985) have suggested a technique of the inquiry audit to determine dependability and confirmability simultaneously. The inquiry audit included a process audit and a product audit; the former audit is used to establish the dependability of the inquiry whereas the latter is used to establish the confirmability (Lincoln & Guba). I hired an auditor to conduct these audits. She was an American professor specializing in qualitative research who taught English writing at a college. She earned her doctoral degree in Educational Curriculum and Instruction from a university in the United States. For the process audit, the auditor examined the processes of data collection and analysis. For the product audit, the auditor ensured the accuracy of the findings and interpretations by reviewing all records and data developed and generated during those processes.

Inter-rater reliability is defined as the extent to which different coders, each coding the same content, come to the same coding decisions (Rourke, Anderson,

Garrison, & Archer, 2001). There were two raters. The raters for conferencing transcripts analysis were myself, the primary investigator, and another researcher in the field of Education Technology. The inter-rater reliability was reported according to our percent agreement. The formula used for calculating percent agreement was Holsti's (1969) coefficient of reliability—$2m/n_1 + n_2$. Here m refers to the number of coding decisions upon which the two raters agree; n_1 refers to the number of coding decisions made by rater 1; and n_2 refers to the number of coding decisions made by rater 2.

First, I trained the second rater on how to conduct the coding; then she completed a coding pilot project. When she disagreed with my coding, we discussed the definitions of the indicators in the particular categories in question until we reached 100% agreement. Problems were encountered initially, mainly because we had different interpretations of some of the indicators. After all coding was completed, inter-rater reliability was 91% for coding surface or deep information processing of conferencing transcripts. Differences were resolved through discussion.

Our main disagreement came from the following situation. Discussion participants sometimes made justifications or inferences without providing a supporting source or adequate information, thus suggesting that personal opinion may have been the basis. In these cases, we could not be sure whether participants' claims were reliable. When this situation occurred, we had to review the assigned readings of that unit discussion in order to render final judgment. If the claim was not justified in the readings, then we finally decided to code this kind of message unit as a fragmentary understanding, even though the contributor made a judgment supported by justification. Two examples

of this type of message follow. In the first example, the contributor claimed that, contrary to Kearsley's (1998) argument, distance education has proven to be a highly efficient means of teaching. The second coder and I considered the claim controversial and thus not adequate justification for dismissing Kearsley's conclusion.

> Kearsley puts forth some valid points about distance education, but is completely off the mark when he states that distance learning is often unsuccessful. I agree with his statement about technology not being the driving force behind the movement, but distance education has PROVEN to be a highly efficient means of teaching. If it were not so, the world would not be rushing to utilize it in the manner that it is. The military, higher education, public schools, and private industry have all acknowledged the benefits of distance education.

In the second example, the contributor did not offer enough information regarding Kearsley's suggestion on the amount and content of counseling and guidance that distance learners need. For this reason, it was difficult to judge the validity of the contributor's justification.

> Kearsley goes on to state that distance learners need a lot of counseling and guidance. This is true, but I believe distance learners go about getting help the same way traditional learners do...they ask a friend first, and then ask the instructor if they still can't figure it out. This isn't any different from students asking for peer tutoring or just leaning over to their neighbor [and asking] how they did that. Kearsley makes some valid points but some of his assumptions are off base.

Limitations

This study was conducted to understand graduate students' perceptions of IO in online classes using text-based CMC technologies. Because the study examined a particular technology format (text-based CMC), results may not be generalizable to online classes using other forms of technology, such as advanced educational CMC environments that incorporate audio and video technologies. Additionally, the study

focused on a specific group of graduate students at a college of education. Therefore, the results may not be generalizable to other groups of students such as undergraduates and to other subject domains such as mathematics and engineering.

Summary

This chapter described the methods and procedures used (a) to understand the difficulties students encountered that contributed to their perceptions of IO in CMC, (b) to observe the impact of those difficulties on students' levels of information processing and interaction with others in online discussions, and (c) to identify students' strategies for avoiding or managing those difficulties in order to engage in quality learning. First, the sample selection was described. Second, data sources and their relation to research questions were explained. Third, data collection procedures were described. Fourth, the analysis section discussed how I analyzed each data source. Fifth, techniques used to achieve trustworthiness criteria were addressed. Finally, the last section stated the limitations of the methods used in this study. Chapter IV discusses the results of my study.

CHAPTER IV

RESULTS

In order to build a basic understanding of their individual cases, I begin this chapter by outlining the distinctions between interviewees, addressing their reported readiness for learning in the current online course (based on their answers to the questionnaire), and perceived information load (as revealed in interviews). Then, I report the findings related to the four research questions concerning: (a) difficulties contributing to students' perceptions of IO in CMC, (b) the impact of those difficulties on students' levels of information processing in online discussions, (c) the impact of those difficulties on students' interaction with others in online discussions, and (d) strategies students used for avoiding or managing IO in order to engage in quality learning.

I illustrated the findings with example quotations from the interviewees. Following each quotation, the interviewee's class and the interview approach were noted in parentheses. Interviews were conducted via one of the following approaches: a face-to-face meeting, abbreviated as "f2f"; an online chat session, marked as "online chat"; or an e-mail, designated as "e-mail."

Overview of Interviewees' Reported Readiness and Perceived Information Load

Table 4 summarizes both interviewees' reported readiness for learning in the current online course (based on data obtained from the questionnaire) and their perceived information load (as revealed in interviews). This table shows that interviewees who were identified as at risk of IO usually experienced difficulties related

to IO. A student was identified as at risk of IO if that person possessed a low level of either prior subject knowledge, English proficiency, or technical skill required to participate in CMC. Students identified as at risk of IO were Don, Frances, and Grace (Class A), and Ivan and Kevin (Class B). Alan (Class A), however, was an exception. Although Alan was identified as at no risk of IO based on data obtained from the questionnaire, his interviews revealed his perception of IO.

A student was also classified into low, medium, or high IO group depending on the degree (identified as low, medium, or high) of difficulty in each area (i.e., quantity of information, quality of information, and medium interface) that person reported in interviews. Students who were determined to have a low degree of difficulty in all three areas were placed in the Low IO group. Those who were determined to have a high degree of difficulty with one or more of the three areas were placed in the High IO group. Other students were placed in the Medium IO group. Accordingly, Eric (Class A), Helen, Jack, and Lily (Class B) were in the Low IO group; Frances and Grace (Class A) were in the Medium IO group; and Alan, Doris (Class A), Ivan, and Kevin (Class B) were in the High IO group. Next, I describe each individual case's learning situation in detail.

It should be noted at this point that Bill and Carl were not included in the discussion. Both were filtered out of the study due to their lack of effort or motivation to fulfill the course requirements. Bill was unable to meet the participation requirements for online discussions. Carl finally dropped out of the course.

Table 4

Summary of Interviewees' Reported Readiness and Perceived Information Load

Student	Learner Readiness			At Risk of IO	Perceived Information Load			IO Group
	Prior Subject Knowledge	English Proficiency	Technical Skills for Participating in CMC		Quantity of Information	Quality of Information	Medium Interface	
Class A								
Alan	high	high	high	no	high	low	medium	high
*Doris	low	medium	low	yes	medium	medium	high	high
Eric	medium	high	high	no	low	low	low	low
Frances	low	high	medium	yes	medium	low	medium	medium
Grace	low	high	high	yes	medium	low	low	medium
Class B								
Helen	high	high	high	no	low	low	low	low
Ivan	low	high	medium	yes	medium	low	high	high
*Jack	medium	medium	medium	no	low	low	low	low
Kevin	high	low	medium	yes	medium	medium	high	high
Lily	medium	high	medium	no	low	low	low	low

Note. * indicates a non-native English speaker.
A student was identified as at risk of IO if that person possessed a low level of either prior subject knowledge, English proficiency, or technical skills for participating in CMC based on data obtained from the questionnaire. A student was also classified into low, medium, or high IO group depending on the degree (identified as low, medium, or high) of difficulty in each area (i.e., quantity of information, quality of information, and medium interface) that person reported in interviews.

Class A

Alan. Alan was a part-time student who was employed full-time. He possessed high levels of prior subject knowledge, English proficiency, and technical skills needed to participate in CMC. According to his self-reported readiness on the questionnaire, he should have been at no risk of IO. However, the difficulties that contributed to his perceptions of IO were based on the quantity of information and the medium interface. Because of those difficulties, he was unable to organize his learning and had navigation problems.

Due to time constraints, Alan was unable to organize his learning to keep up with the pace of the class. He had a full-time job that required him to work 8 hours per day, 5 days per week. He was taking one other online class in addition to this one. It was a challenge for him to deal with two online classes when he could study only at night and on weekends. Given his limited study time, he perceived the course workload to be high. He reported that the required readings, numerous ongoing learning activities, and frequent online discussions ate up most of his time. He further indicated that he would have been able to manage the class better if he had not been working full time.

> Alan: It is hard to get on every night when you have multiple classes. We have so much to do in this class. I usually spend 2–3 hours a night, 5–6 days a week on course work [for this class only]. About half online, about half reading. Even with that, it seems I'm always behind. And it seems we have something due every other day at least....And then when you get on there is more reading! (Class A, online chat)

Alan also encountered some navigation difficulties in FirstClass. He indicated that those students who participated in online discussions in order to meet the participation requirement generated many short messages that, in turn, made browsing

difficult. He described his feeling towards online discussions: “In a word overwhelmed....I especially despise forced discussion. So many short messages make browsing difficult” (Class A, online chat).

He added that he liked the display of multiple-level threaded discussions offered by Web Board. FirstClass does not support this kind of display, although it can work similarly. However, he further indicated that some students in the class tended to change the discussion topic without creating a new thread, thereby confusing other participants.

> Alan: But I like the way threads can cascade sequentially in WWWBoard. FirstClass could work similarly, but users never change the subject line when the conversation branches! (Class A, online chat)

Doris. Doris was a full-time student who was not employed. She possessed a low level of prior subject knowledge; she had a different major and had not taken any relevant courses previously. As a non-native English speaker from Asia, she was at a disadvantage in terms of English competence. She possessed a medium level of English reading and writing proficiency. She possessed few of the technical skills required to participate in CMC. Obviously, she was a novice in terms of both course content and context. Hence, she was identified as at risk of IO. Doris worried about numerous ongoing learning activities every day and was unable to link discussion messages. She experienced connection problems, disorientation in computer conferencing, and was uncomfortable communicating online. All of these difficulties contributed to her high perceived information load due to the quantity of information, quality of information, and the medium interface.

The quantity of information—specifically, the numerous ongoing learning

activities—contributed to Doris' perception of IO. Doris responded that she worried a lot about this class and often thought about its learning activities because "[assignments are] very tough. There are so many things to do." She indicated that she had to be online at least two times a day in order to keep up with the pace of the class.

The quality of information—specifically, the inability to link discussion messages—contributed to Doris' perception of IO. This difficulty was attributed to the non-linear format of FirstClass computer conferencing and its inability to support multiple-level display.

> Doris: Sometimes I missed something. I think the most difficult problem is that I can't tell from the screen which one [message] is replied to which person. I can't match the opinions to the other person. I cannot match that, but I should.…I think it is more convenient if I can tell from the screen who replies to whom. (Class A, f2f)

Doris' perception of IO from the medium interface was high. The difficulties she encountered that contributed to her medium overload were connection problems, disorientation in computer conferencing, and discomfort with online communication. At the beginning of the semester, Doris was unable to log on to the computer conferencing system because she could not find the setup and installation guidelines on the course website. Finally, the instructor helped her to solve the problem at the orientation meeting.

> Doris: Actually, I am not that much of a computer person, so I am not very comfortable about that. At first, I didn't know what to do and how can I connect this one, so I had a very a little bit hard time.…But there is nothing about the software. Maybe there is, but I couldn't find it. (Class A, f2f)

Doris reported feeling disoriented by multiple windows in FirstClass. She often

had to open several windows in order to get to the target window that she needed to work with.

> Doris: There are so many things on the screen and this bar down here is full. If I want to read two writings at the same time, then I should find one of the replies here [the bar]. It is difficult. I need to open everything to get [to] it. (Class A, f2f)

She was uncomfortable communicating with people online because of her language difficulties and her inexperience with CMC. She reported feeling uncomfortable with her English writing ability and, hence, with her capacity to post messages in public. She often worried that people did not understand her writing or that she might make some mistakes in writing that everyone would then see.

> Doris: Well, so far I am uncomfortable because I [am] always worried about my English. But, in conversation, my English is not left. But the writing stays always left, and there are some kinds of evidence there. So I should be very careful about writing. (Class A, f2f)

Doris explained that she preferred face-to-face communication and could not get used to this kind of online communication. People's facial expressions and body language helped her to understand conversations better.

> Doris: Sometimes I feel speaking is better than writing because we can understand from another person's expressions or body languages or some kinds of the personal movements that kind of things.…Sometimes when I cannot receive the letters, or just replies about my opinions, then sometimes I think, oh, is there something wrong about me, or something wrong about my English, or something wrong about my attitude. (Class A, f2f)

Eric. Eric was a full-time student who was employed part-time. He possessed a medium level of prior subject knowledge. His reported levels of English proficiency and technical skills for participating in CMC were both high. According to this self-reported

readiness, he had no risk of IO. He responded that he did not encounter any major difficulties and that he enjoyed learning online because he could study any time that he felt ready to do so. He had a regular study plan and was online several times every day to keep up with the online discussions. Eric indicated that there were a number of things that he appreciated about this kind of online environment compared to on-site classroom learning. In particular, he mentioned a more organized syllabus and increased class structure.

Frances. Frances was a part-time student who was employed full-time. She possessed a low level of prior subject knowledge, a high level of English proficiency, and a medium level of technical skills required to participate in CMC. According to this self-reported readiness, she was identified as at risk of IO. Frances declared that this class was very organized and the requirements were very clear. However, the difficulties that contributed to her perceptions of IO were based on the quantity of information and the medium interface. Frances found the numerous ongoing online discussions and the seemingly endless resources available on the Internet overwhelming and disorienting.

> Frances: Since there are so many resources that are provided, I have still not figured out how to get through all of them. There are just so many! I just read as many as I can because they are all relevant. It is sometimes time consuming just to get through required readings let alone supplemental reading. (Class A, e-mail)

Although Frances encountered numerous ongoing online discussions and felt disoriented when browsing some Web resources, she responded that she was online every day to keep up with the pace of the class and limited herself to navigating on the course website only. “Sometimes they can be a bit overwhelming. You are lost in a sea of

red flags. You MUST keep up every day." "I sometimes get overwhelmed with the Internet links available. The thing with hypertext is that the links never seem to end. I just have to limit myself to reading the website info that was assigned" (Class A, online chat).

Grace. Grace was a part-time student who was employed full-time. She possessed a low level of prior subject knowledge and a high level of English proficiency, as well as the technical skills necessary to participate in CMC. Given this self-reported readiness, she was identified as at risk of IO. Grace indicated that she did not encounter any major difficulties in the course. However, she commented that it was challenging to organize learning with numerous ongoing learning activities, including discussions that lasted all week long. She reported that she did not have a specific study schedule. She just tried to do as much as she could each evening and kept up on the weekends. She found the schedule of assignments confusing: "I wish there was a calendar with all the assignments in one place.…I have been working on my own calendar, but I wish there was one sponsored by the professor in case of changes, my mistakes, etc." She also noted that she did not like the multiple conference rooms in FirstClass: "I did not like that you had to have so many windows open. It would have been nice to have things open in one window. I don't like subfolders within folders" (Class A, online chat).

Class B

Helen. Helen was a full-time student who was employed part-time. She possessed high levels of prior subject knowledge, English proficiency, and technical skills needed to participate in CMC. Given this self-reported readiness, she was

identified as at no risk of IO. In the interview, she responded that she did not encounter any difficulties in the course. She enjoyed learning online because she could schedule it at any time of day or night and did not have to drive to the campus. Helen further explained that she actually spent more time on this kind of class than she did on on-site classes and that she was able to be more involved in the learning process. She had a regular study plan for this class and was online almost every day.

> Helen: I usually take care of it [the work] on…Thursday and Saturday for the assignment due on Monday. So I broke up time on Thursday and on Saturday to get the work done. I kind of log on all week long for online discussions. (Class B, f2f)

Ivan. Ivan was a part-time student who worked full-time. He possessed a low level of prior subject knowledge, a high level of English proficiency, and a medium level of technical skills required to participate in CMC. Given his self-reported readiness, Ivan was identified as at risk of IO. The difficulties that contributed to his perceptions of IO were based on the medium interface and the quantity of information. He experienced connection problems and was uncomfortable with online communication.

Ivan had no Internet connection at home at the beginning of the semester. Additionally, due to the firewall problem in the district where he worked, he was unable to access the required weekly readings electronically from the library. Ivan reported: "My computer technology person at my school called the library to get help, and they talked for a while and still couldn't get it [to] work." Ivan ultimately found a colleague whose computer was able to access the library's electronic materials. "I have to go to ask him once a week to print out materials for me because he is the only one who can access it on his computer." Because of the firewall problem and no Internet connection at home,

he was two weeks behind the rest of the class at the beginning of the semester. Later on, he ordered an Internet connection at home in order to complete work for the class.

> Ivan: Ah, well, I have so many problems with the firewall. The first week that my group came up, but I missed it. I was two weeks behind everybody else because of the situation with the firewall. And then finally we had to order that Internet at home and then I have to catch up. (Class B, f2f)

The high demands of Ivan's job and his family responsibilities also made it challenging for him to catch up and finish reading all of the required texts.

> Ivan: I was frustrated. I told her [the instructor], too. I e-mailed her. I said "Look, if I can't get this, I am finished. I have to drop…your course." I got a feeling that she is going to work with me. But I was frustrated, because I have three baby kids at home, I have three little girls and a wife, you know, and my wife wants…attention, and I am taking another class. I don't have time. (Class B, f2f)

Ivan also commented that there were too many assigned readings during the first and second weeks of the semester. He suggested that there be fewer assigned readings in this period so that students could take the time they needed to become familiar with the online environment.

> Ivan: It was very frustrating, because it was so many readings at the beginning. If you get behind at the beginning, that's not good. If it gets started and you are slow. Maybe just have one reading at the first week, and then two readings at the second week, and you know, a couple of readings, you know, if until we get familiar with it [the online environment], that will be great.…She started out with three long readings,…, so I have eight articles in two weeks. I was already behind because I didn't have the Internet.…so when she started it out so fast, that's not good. (Class B, f2f)

Ivan felt uncomfortable communicating online for a variety of reasons: he commented that online communication was a time-consuming process, he read slowly from the computer screen, and he regarded himself as computer illiterate.

> Ivan: I think that Web Board stuff is time-consuming and difficult. One, I am a slow reader [from a computer screen], and that takes me a lot of time reading them. Second, I am not computer literate. Again, it is time-consuming. (Class B, f2f)

Jack. Jack was a full-time student who was employed part-time. He possessed a medium level of prior subject knowledge, English proficiency, and technical skills required to participate in CMC. An immigrant from a Latin American country, Jack spoke English fluently. Given his self-reported readiness, he was identified as being at no risk of IO. In the interview, he responded that he did not encounter any major difficulties in the course and enjoyed the learning experience. Jack explained that he had participated in similar Web Board discussions through the Internet before, so he had no problem at all with this learning environment. Furthermore, his wife was a full-time housewife who took care of everything for him, so he could focus exclusively on his job and on learning without the family distractions other students had encountered.

Kevin. Kevin was a full-time student who was employed full-time. He possessed a high level of prior subject knowledge, a low level of English proficiency, and a medium level of technical skills required to participate in CMC. Given this self-reported readiness, he was identified as at risk of IO. Kevin had a regular study plan and was online at least twice a day to check discussion messages. The difficulties that contributed to his perceptions of IO were based on the quantity of information, quality of information, and the medium interface.

Kevin declared that he was a slow reader with visual and auditory learning styles. He had problems managing course materials that were exclusively text-based.

> Kevin: I have a little problem with the all written [materials]. I am more

> an auditory learner. I am a little visual learner.…Sometimes reading the articles is very, I want to say, flat, because you reach that information but I don't really see it. (Class B, f2f)

Kevin sometimes had to read material several times in order to understand the contents. He noted that looking at fellow students' assignments, participating in online discussions, and having a discussion with other students in person alleviated this difficulty.

> Kevin: For me, because I am a slow reader, it's [the course work] entirely too much to do in one semester. However, going back and reading what other people's doing,…I read those stuff and they give me ideas and they help to keep me on track. They keep me on track if I have totally different opinions. (Class B, f2f)

He also encountered a variety of navigation difficulties in Web Board. He preferred messages sorted by date, not by topic, and off-topic discussions confused him.

> Kevin: (Pointing to the Web Board discussions on the computer screen) It's too busy to me. That bothers me. I just like to have them [the messages] sorted by date. I feel more structured that way. And I don't like this breakdown. It's all right. It's just confusing and [seems] too busy to me. I don't know. In fact, they [the messages] get posted all together. If you look at certain people's stuff, by the time you will be out of consistency. It is sorted by topic, not by date. This topic is related to this. This could shift to be related to this one. That's not the way I [am] used to. (Class B, f2f)

> Kevin: The subject could be changed and comes back over here. That's why there are at least three subjects changed. These people don't know how to use it [the threaded structure of discussion messages], so these [messages] posted here maybe really reflect to this [a different] conversation. They don't realize they just added on to this one when they really want to comment on that one. So that's kind of confusing to me. (Class B, f2f)

Kevin preferred to receive discussion messages via his personal e-mailing system instead of reading those messages in Web Board. He reflected, "It's like being in a big room; there are four, five people talking, and I can only talk to one [at a time]. It's very

confusing." For these reasons, Kevin had the discussion messages sent to his personal e-mail so that he could read and manage them there. He sometimes encountered difficulties with this method, forgetting previous messages relevant to the one he was reading in his mailbox. In those cases, he had to go back to Web Board to pick up the conversation.

> Kevin: Sometimes they [the discussions] get a little confusing, then I need to go back to the Web Board occasionally to pick up what they [the students] are talking [about]. I prefer to get an e-mail and read them [the messages] that way. But occasionally I can't remember who's talking [about] what, so I go back [to the Web Board] and look. I don't know, the formatting [of the Web Board] just seems to be sometimes confusing. That just seems [that the] last person has to jump around to figure out who's doing what, what they are talking about. (Class B, f2f)

Lily. Lily was a full-time student who was employed part-time. She possessed a medium level of prior subject knowledge, a high level of English proficiency, and a medium level of technical skills required to participate in CMC. Given her self-reported readiness, she was identified as at risk of IO. In the interview, she responded that she did not encounter any difficulties in the course. She liked this class a lot because she could schedule the work for any time. She also indicated that it was fairly easy to interact, communicate, and submit assignments in this environment. Lily commented that the instructor organized the course very well and that everything was clear to her. Lily had a regular study plan and liked to check discussion messages early every morning. She sometimes got online during the day when she had time.

Difficulties Contributing to Perceptions of Information Overload in CMC

This section reports the findings related to the first research question: When they learn through the medium of CMC, what difficulties do students experience that

contribute to their perceptions of information overload? Interviewees experienced a number of difficulties in the online courses they were taking. I have organized these difficulties into six broad categories: (a) connection problems, (b) navigation difficulties, (c) discomfort with online communication, (d) numerous ongoing discussion messages and endless resources, (e) difficulty in organizing learning, and (f) problems understanding the assigned readings. Based on these findings, I proposed a model of online students' perceptions of IO to illuminate the phenomenon of IO in educational CMC.

Connection Problems

Doris (Class A) and Ivan (Class B) were the only 2 students out of 10 who reported that they encountered connection problems at the beginning of the class. Doris reported that she possessed only a low level of the technical skills needed to participate in CMC; Ivan reported a medium level of technical skills. Doris was unable to log on to the computer conferencing system during the first week of the semester. She resolved this connection problem at the orientation meeting with the instructor's help. Doris' initial failure to set up the connection can be attributed to two factors. First, she was uncomfortable reading text from the computer screen.

> Doris: Actually I am not comfortable…reading some contents on [the] computer monitor. So I just print out everything, every syllabus, every every content about the assignments. I just print out everything and read them. (Class A, f2f)

Second, because she was a novice online learner, she needed to pay attention to numerous practical issues, including: how to set up the connection, how to use the software, how to take this kind of class, how the class was structured, etc. As a result of

these concerns, combined with her discomfort in reading from the computer screen, she failed to attend to the connection instructions for FirstClass from the course website. Doris remarked: “But there is nothing [on the course website] about the software. Maybe there is, but I couldn’t find it.” Doris was not aware that this information was on the Web until I interviewed her.

Ivan, at the beginning of the course, had no Internet connection at home and experienced a significant problem with the firewall where he worked. He ordered an Internet connection for his home, but then encountered the same firewall problem there. This firewall problem meant he was unable to access the electronic materials from the library. These materials were vital to the course. They constituted the required weekly readings; students needed to read them all in order to be able to do the assignments. Ivan spent a long time trying to resolve this problem with the help of a colleague who was a computer expert; however, the problem still existed even when the semester was over. Ivan was so frustrated by this technological problem that he became distracted from learning course content. He was behind at the beginning of the course and remained behind in his coursework for the duration for about five weeks, as exhibited by participating late in each week’s online discussion.

Navigation Difficulties

Alan, Doris, Frances (Class A), Ivan, and Kevin (Class B) were the 5 students out of 10 who encountered navigation difficulties. Those difficulties included disorientation when browsing the Web and computer conferencing, and difficulty linking discussion messages.

Some students felt disoriented by the Web. Most students indicated that the course websites were very organized. Their disorientation came from other Web resources, which were organized in a hypertext structure of more than three levels. Alan, for example, commented: "[To avoid disorientation] I typically don't open more than three links deep, unless I feel I am getting closer to the information I seek" (Class A, online chat).

> Kevin: Some pages [are] just awful. There are too many dead links. They don't know how to look things back. They don't know how to go back to the beginning. If the situation is bad, I will just close it and start over. I really like a site map…[where] I can see everything going there. I think two or three levels are deep enough. If beyond that, I personally think people easily get lost. (Class B, f2f)

Perceived disorientation in FirstClass was due to the multiple conference rooms. Students felt disoriented by the sub-conferences within conferences in FirstClass. They usually had to go through several conferences in order to get to the target sub-conferences. Consequently, the computer screen was full of windows that displayed the various conferences. When they were still unfamiliar with the computer conferencing structure and were unaware of their target location, some students spent a lot of time trying to find the target conference and became frustrated.

Several students found it difficult to link discussion messages. When the discussions were busy, the threaded structure of messages within both FirstClass and Web Board was confusing to students. The confusion was worse in FirstClass because it does not support multiple-level threads the way Web Board does. Some students could not tell from the screen which person had replied to which message. As a result, the discussion became incoherent for these students. One student (Kevin) offered a vivid

metaphor to describe his confusion when the online discussions got busy: “It was like you sat in a room and talked to four or five persons at a time. Very confusing.” Off-topic discussions (in which someone changed the discussion topic without creating a new thread) made the situation worse.

> Kevin: (Pointing to the Web Board discussions on the computer screen) That bothers me. I just like to have them [the messages] sorted by date. I feel more structured that way.…In fact, they [the messages] get posted all together. If you look at certain people's stuff, by the time you will be out of consistency. It is sorted by topic, not by date. This topic is related to this. This could shift to be related to this one. That's not the way I [am] used to.
>
> Interviewer: Oh, it depends on how people change the subjects.
>
> Kevin: Right. The subject could be changed and comes back over here. That's why there are at least three subjects changed. These people don't know how to use it [the threaded structure of discussion messages], so these [messages] posted here maybe really reflect to this [a different] conversation. They don't realize they just added on to this one when they really want to comment on that one. So that's kind of confusing to me. (Class B, f2f)

Discomfort with Online Communication

Doris (Class A) and Ivan (Class B) were the 2 students out of 10 who were uncomfortable communicating online. This discomfort can be attributed to their lack of technical skills for participating in CMC and their lack of efficiency (speed and comprehension) in reading from computer screens. First, Doris indicated that she was not a computer person. Likewise, Ivan identified himself as computer illiterate. They both needed to make a greater cognitive effort to figure out how to interact with the medium interface, while simultaneously having to process the discussion messages.

Second, both Doris and Ivan indicated that they were not used to reading from a computer screen. This lack of familiarity added to their discomfort in communicating

online. Doris expressed the difficulty of understanding the information on the computer screen and had to print everything from the course website to read or study.

> Doris: I print it [the online material] out and read because I can't catch the key concepts on the monitor. I am not familiar with the monitor. Then I read the print, and highlight the important messages. (Class A, f2f)

Doris' language skills presented her with an additional obstacle.

> Interviewer: So, you still can't get used to read on the monitor, right?
>
> Doris: In XXX [her first language], yes. In English, no. In XXX [her first language] I can because I read lots of things in XXX [her first language] Internet, something like literature or novel on the monitor in XXX [her first language]. (Class A, f2f)

Ivan reported that he read slowly from the screen, but indicated that he could read quickly from printed text because he had acquired speed-reading techniques while in high school. Ivan's slow speed in reading from computer screens, his lack of computer skills, poor typing skills, and job- and family-related time constraints might have made him feel reluctant to participate online. This consequence led to infrequent logons, and subsequently, discussion messages were accumulated in Web Board. He felt overwhelmed with everything he had to do.

Third, Doris' English competence might have been a major factor influencing her discomfort online. She noted that she did not like to post her English writing and have it reviewed by others, especially her American counterparts. She worried that people were unable to understand her writing. Additionally, she knew that if she made errors in writing, everybody saw them. In an attempt to avoid embarrassment, she usually spent a long time composing her messages before posting them.

Finally, both Doris and Ivan commented that online communication was a

time-consuming process and that they preferred face-to-face communication. Ivan appreciated the opportunities that on-site classroom learning offered for immediate dialogue and more interaction with the experts, as shown in the following description.

> Ivan: Face to face I would say it's better because that's more dialogue. You can hear more people at once….I've thinking to get around the professional person. You don't get that personal touch. Dr. T is a very intelligent man and I have been enjoying [being] around him and listening to him. (Class B, f2f)

Doris needed people's social cues, including facial expressions and body language, to help her understand conversations better.

Numerous Ongoing Discussion Messages and Endless Resources

Numerous ongoing discussion messages, along with the many resources provided on the course website, made students feel that they had voluminous information to process. Alan, Doris, and Frances (Class A) were the 3 students out of 10 who encountered this difficulty. For Alan, this difficulty was a product of time constraints. He was very busy: he had a full-time job and was taking another online course in addition to this one. As a result, he perceived that he did not have enough time to process all learning materials and discussion messages; he always felt he was behind the rest of the class.

Doris and Frances can both be regarded as devoted learners who took responsibility for processing as much course information as possible. Their difficulty with the volume of course information could be attributed to their lack of prior subject knowledge. Neither Doris nor Frances had experience in the field of educational technology. They did not possess enough knowledge to determine which materials were

most relevant to meeting the course requirements effectively. Doris' English proficiency hindered her here. She faced an additional problem. Due to the medium interface, she was unable to link discussion messages (she could not tell who replied to whom in computer conferencing). As a result, she often became overwhelmed when processing online messages.

However, Alan and Doris finally adopted selection strategies to determine discussion messages and materials to read or study based on their relevance to fulfilling the course requirements. Conversely, Frances, even at the end of the semester, still deemed all information relevant and tried to read as much as she could.

Difficulties in Organizing Learning

Alan, Doris, Grace (Class A), and Kevin (Class B) were the 4 students out of 10 who expressed difficulties in organizing their learning. They all indicated that it was challenging to organize learning when there were numerous ongoing learning activities, including continual online discussions. Their demands of job, family responsibilities, or both, compounded this problem. Alan was taking another online course, which made the situation worse for him. Doris was a first-time online learner; she had to adjust herself to the differences of this mode of learning from the format of regular once-a-week on-site classroom learning. At the end of the semester, Alan and Kevin still struggled with this difficulty.

Problems Understanding the Assigned Readings

Kevin (Class B) was the only person out of 10 who reported this difficulty. He explained that he had a problem understanding the assigned texts on his own; he could

no longer rely on the instructor's lectures and verbal discussions for help as he had previously in traditional classroom learning. This difficulty could be attributed to Kevin's being both a novice online learner and a slow reader with visual and auditory learning styles.

First, Kevin probably faced additional difficulties as a first-time online learner. He might have needed to adjust himself to this form of text-based learning. In classroom learning, students usually scan the course reading materials and identify questions before they go to the classroom. They gain understanding and solve problems through the lecture, or through the verbal discussions and the question and answer periods. From this process, students get something that they are unable to learn on their own. Online learning is very different. Here, everything students learn, they learn from text-based assigned readings, which demand reading and writing abilities.

Second, he declared that he was a slow reader with visual and auditory learning styles. Visual learners are those who learn by seeing; auditory learners must hear what they are learning in order to really understand it (Reiff, 1992). Both variables evidently disadvantaged Kevin in processing written materials. This diagnosis is consistent with the self-report of his English proficiency (obtained from the questionnaire). Although he was a native speaker, Kevin perceived his English reading and writing competence to be at only a fair level. With the exception of Kevin, all the native English-speakers in this study reported their English proficiency to be at a fluent level.

Proposed Model of Online Students' Perceptions of Information Overload

Figure 3 is a proposed model of online students' perceptions of IO, illuminating

the phenomenon of IO in educational CMC. Although all students were exposed to the same amount of information in the same learning environments, different individuals experienced different degrees of IO. Varied learner characteristics (including knowledge/skills variables and personal variables) led some students to be more susceptible to IO than others. Those knowledge/skills variables (i.e., a lack of the technical skills required for participating in CMC, a lack of efficiency in reading from computer screens, inadequate prior subject knowledge, and inadequate English proficiency) and personal variables (i.e., time constraints, and visual and auditory learning styles) likely led to students' difficulties in one or more of the following different dimensions: medium interface, quantity of information, and quality of information. As shown in Figure 3, problem areas within each of these different dimensions were also identified. For example, connection problems, navigation difficulties, and discomfort with online communication were the three most common problem areas students experienced with the medium interface. The quantity of information also posed a problem for some students who found the numerous ongoing discussion messages and the seemingly endless resources overwhelming. This vast quantity of information with limited time to process made it difficult for some students to organize their learning. In terms of the quality of information, the text-based assigned readings themselves also created processing problems for some students. Those difficulties that students encountered within these dimensions, in turn, contributed to students' overall perceptions of IO. Consequently, IO was usually a result of no one variable, but of a mixture of several variables.

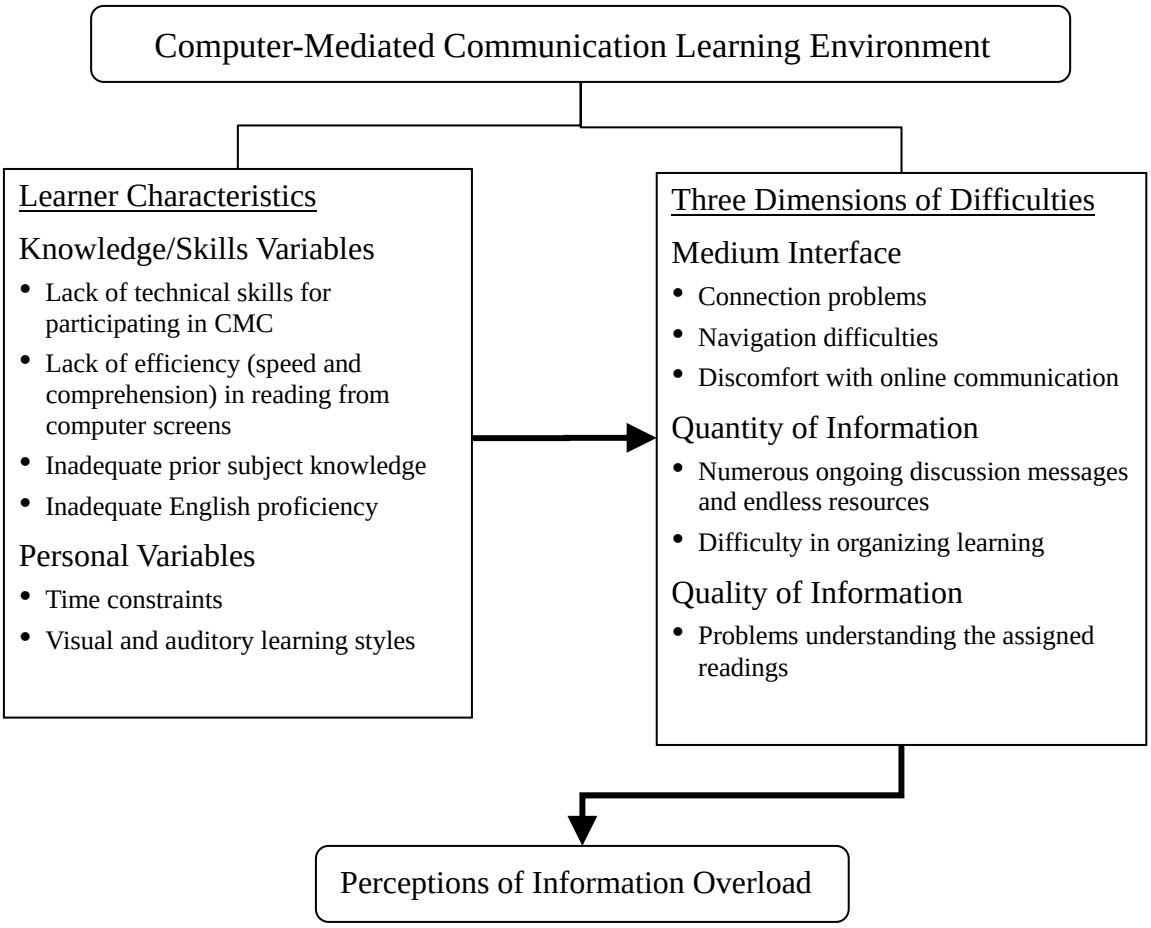


Figure 3. **Proposed Model of Online Students' Perceptions of Information Overload**

This section reported the difficulties students encountered that contributed to their perceptions of IO when they learn through the medium of CMC. Those difficulties included connection problems, navigation difficulties, discomfort with online communication, numerous ongoing discussion messages and endless resources, difficulty in organizing learning and problems understanding the assigned readings. Based on these findings, I proposed a model of online students' perceptions of IO to

illuminate the phenomenon of IO in educational CMC. The model not only summarized the difficulties, but also presented the variables that likely led students to those difficulties.

Levels of Information Processing

This section reports the findings to the second research question: Do those difficulties affect students' levels of information processing (surface or deep processing) as observed in their discussion messages? Interviewees' discussion messages—from the beginning week of the online discussions through to the sixth week of the semester (when they reported that their difficulties occurred)—were analyzed. The depth of processing ratios of all interviewees was examined in order to determine whether those difficulties affected their surface or deep information processing. The results indicated that those difficulties tended not to affect those interviewees' levels of information processing.

Table 5 presents the depth of processing ratios of students in both classes (divided according to IO group). The average depth of processing ratio for High IO group was 0.81 (ranging from 0.50 to 1.00). The average depth of processing ratio for Medium IO group was 0.62 (ranging from 0.43 to 0.82). The average depth of processing ratio for Low IO group was 0.41 (ranging from 0.31 to 0.56). Interestingly, High IO group tended to have higher depth of processing ratios than Low IO group. The average depth of processing ratios for the two classes were both above 0.50 and were, in fact, not substantially different: average depth of processing ratio for students in Class A was 0.66; the average depth of processing ratio for students in Class B was 0.56. Table 5

also shows that all students (in both classes and in all three IO groups) exhibited deep processing. With the exception of Alan and Kevin, they all also exhibited surface processing as well.

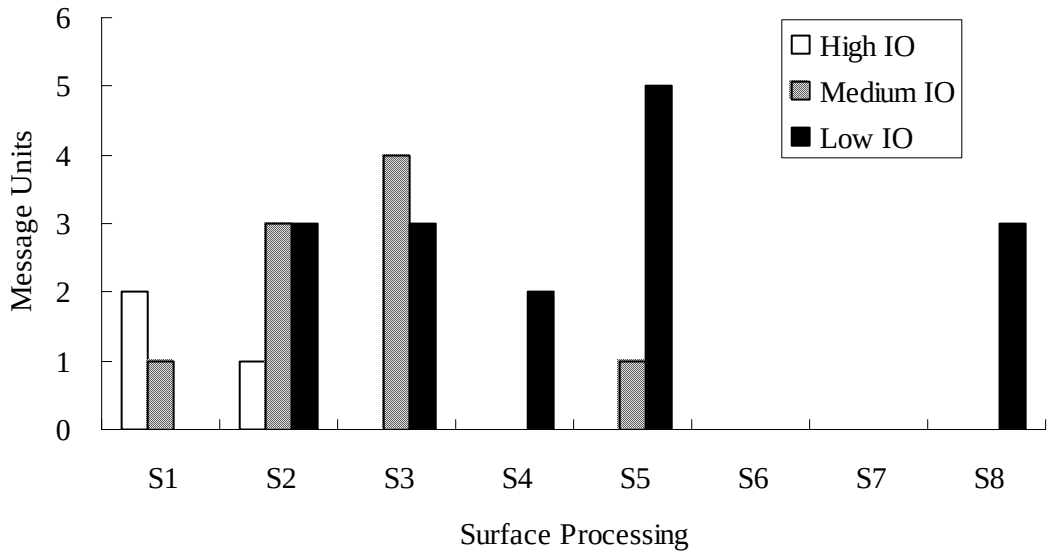
Table 5

Interviewees' Depth of Processing Ratios

Student (n = 10)	Class	X^+	X^-	Depth of Processing Ratio
High IO Group				(average = 0.81)
Alan	A	13	0	1.00
Doris	A	14	2	0.75
Ivan	B	3	1	0.50
Kevin	B	7	0	1.00
Medium IO Group				(average = 0.62)
Frances	A	31	3	0.82
Grace	A	15	6	0.43
Low IO Group				(average = 0.41)
Eric	A	17	9	0.31
Helen	B	7	2	0.56
Jack	B	5	2	0.43
Lily	B	6	3	0.33

Note. Average depth processing ratio of Class A = 0.66.
Average depth processing ratio of Class B = 0.56.
X^+ = total units of deep processing.
X^- = total units of surface processing.
Depth of processing ratio = $(X^+ - X^-) / (X^+ + X^-)$, converting the counts to a -1 (all surface) to +1 (all deep) scale.

Figure 4 provides an overview of those messages posted by all interviewees in both classes (divided according to IO group) that demonstrate surface processing.



Note. S1-S8 = codes used to represent 8 indicators of surface processing according to Henri's (1992) model.
S1 = Repeating the information without further elaboration.
S2 = Repeating what has been said without offering new information.
S3 = Stating that one shares the ideas or opinions stated, without taking these further or adding any personal comments.
S4 = Proposing solutions without offering explanations.
S5 = Making judgments without offering justification.
S6 = Asking questions which invite information not relevant to the problem or not adding to the understanding of the problem.
S7 = Offering several solutions without suggesting which is most appropriate.
S8 = Perceiving the situation in a fragmentary or short-term manner.

Figure 4. **Distribution of Messages Presenting Different Examples of Surface Processing**

Using Henri's (1992) model as a guide, it may be concluded that the students processed information superficially based on their use of six of the eight indicators of surface processing:

- they repeated what was said without further elaboration or without offering new information;
- they posted compliments, agreements, or supportive comments without further elaboration;
- they offered solutions or judgments without evidence of elaboration or justification; and
- they demonstrated fragmentary understanding of the course contents by giving wrong interpretations or injecting unreliably equivocal knowledge without indicating their sources as justification.

Whereas the Medium and Low IO groups posted supportive comments or acknowledgement for fellow students, the High IO group did not offer these kinds of messages. The only messages that the High IO group posted were S1 (repeating the information without further elaboration) and S2 (repeating what has been said without offering new information). There are some possible explanations for this observation. First, the High IO group might have experienced difficulties processing information effectively. Therefore, in order to receive a full participation credit, they offered repetitive information. Second, the High IO group might have had to spend more time on processing messages, and, hence, they did not have the time to post supportive comments and interact socially with their peers. Instead, they tended to be rather driven

toward task-oriented conversation. Third, the Low IO group tended to post more superficial messages because they probably deemed online discussions as a type of informal conversation.

This section reported all interviewees' depth of processing ratios in order to determine whether those difficulties contributing to their perceptions of IO affected their surface or deep information processing. The results indicated that those difficulties tended not to affect those interviewees' levels of information processing as observed in their discussion messages.

Online Interaction

This section reports the findings relevant to the third research question: Do those difficulties affect students' interaction with others in online discussions? Interviewees' discussion messages—from the beginning week of the online discussions through to the sixth week of the semester (when they reported that their difficulties occurred)—were analyzed. In order to determine the impact of difficulties on online interaction with others, special attention was paid to the different interaction patterns exhibited by interviewees. The results indicated that those difficulties might influence students' interaction with others in online discussions.

Table 6 illustrates the interaction patterns for Class A. It identifies the interactive processes in which each student engaged for each discussion question. Class A was organized into two units; from the third week (the beginning week of Class A discussions) through to the sixth week of the semester. Each unit lasted two weeks and contained three discussion questions. Discussion participants had to post a minimum of 5

substantive messages for each unit discussion. Discussion co-facilitators had to post 3 discussion questions prior to the beginning of the unit, moderate the discussions throughout the unit, and synthesize the discussions at the end of the unit. As was described specifically in the syllabus, assessment of the students' contributions depended on both their quantity and the quality.

Students in the High IO group tended to participate only minimally in discussions. It should be noted that Alan (in the High IO group) did not receive the full participation credit for unit 1; he posted only 3 messages. This result is consistent with his responses in the interview, where he indicated that he had problems keeping up with the pace of the instructions. In unit 2, Alan was a co-facilitator who was responsible for moderating discussion question 3; therefore, he posted no messages to the other two questions. Another student (Doris, who was in the High IO group) met the basic requirements for both units; she made a total of 5 postings for unit 1 and a total of 6 postings for unit 2.

Students in the Medium IO and Low IO groups tended to post more messages than students in the High IO group. Whereas Frances, Grace (in the Medium IO group), and Eric (in the Low IO group) posted a total of 24, 14 and 20 messages, respectively, Alan and Doris (in the High IO group) posted a total of 10 and 11 messages, respectively.

Table 6

Interaction Patterns Exhibited by Each Interviewee in Class A

Discussion Unit	Discussion Question	Interactive Process	IO Group				
			High		*Medium*		*Low*
			Alan	Doris	Frances	Grace	Eric
Unit 1	Question 1	Explicit	1	0	4	2	2
		Implicit	0	0	0	1	0
		Independent	0	1	0	2	1
	Question 2	Explicit	1	0	0	2	1
		Implicit	0	0	0	0	0
		Independent	0	1	1	1	0
	Question 3	Explicit	0	2	6	0	5
		Implicit	0	0	0	0	0
		Independent	1	1	1	0	1
Subtotal number of messages			3	5	12	8	10
Unit 2	Question 1	Explicit	0	2	5	1	4
		Implicit	0	0	1	0	0
		Independent	0	1	0	0	0
	Question 2	Explicit	0	1	4	1	4
		Implicit	0	0	0	0	0
		Independent	0	1	1	1	1
	Question 3	Explicit	6	0	0	2	0
		Implicit	0	0	0	0	0
		Independent	1	1	1	1	1
Subtotal number of messages			7	6	12	6	10
Total number of messages			10	11	24	14	20

Note. Explicit = a direct response to or a comment on a specific message/student.
Implicit = an indirect response or comment in which the content of another student's message was mentioned, but not that person's name.
Independent = a message that stood alone without referring to any other messages/students, or a message that answered the discussion question.
"No interaction" pattern = "0 0 *X*" (*X* refers to any number).
"One interaction" pattern = "1 0 *X*", and "0 1 *X*" (*X* refers to any number).
"Two interactions" pattern = "2 0 *X*", "1 1 *X*", and "0 2 *X*" (*X* refers to any number).
"Above two interactions" pattern = patterns not belonging to "no interaction", "one interaction", and "two interactions."

Table 7 illustrates the interaction patterns for Class B. It identifies the interactive processes in which each student engaged for each discussion question. Class B consisted of 5 units; from the second week (the beginning week of Class B discussions) through to the sixth week of the semester. Each unit lasted one week and contained no specific discussion questions. The unit co-facilitators were expected to post any discussion questions or bring up issues relating to the assigned readings for discussion. The discussions were conducted in a more open manner than were those of Class A. Discussion participants were not expected to post a specific number of messages for each unit; however, the unit co-facilitators were required to post a minimum of one message.

Unlike Class A, in Class B, all students (in all IO groups) posted a similar number of messages. It should be noted that Ivan (who was in the High IO group) posted no messages in unit 1. He had difficulty participating in the unit 1 discussion due to connection problems. Because of the previously mentioned firewall problem, he was unable to obtain the assigned readings from the electronic reserves service in the library. Additionally, he had no Internet connection at home for about two weeks at the beginning of the semester. The conferencing transcript records also show that Ivan was behind the rest of the class for the five weeks observed (he participated one day late in every unit). Another student in the Low IO group (Jack) barely met the basic requirements for every unit, whereas other students displayed much more active involvement in discussions.

Table 7

Interaction Patterns Exhibited by Each Interviewee in Class B

Discussion Unit	Interactive Process	IO Group				
		High		*Low*		
		Ivan	Kevin	Helen	Jack	Lily
Unit 1	Explicit	0	2	1	0	1
	Implicit	0	0	0	0	0
	Independent	0	0	0	0	1
Subtotal number of messages		0	2	1	0	2
Unit 2	Explicit	1	1	1	1	1
	Implicit	0	0	0	0	0
	Independent	0	0	0	1	0
Subtotal number of messages		1	1	1	2	1
Unit 3	Explicit	1	0	0	1	2
	Implicit	0	0	0	0	0
	Independent	0	0	0	0	0
Subtotal number of messages		1	0	0	1	2
Unit 4	Explicit	1	3	4	0	2
	Implicit	0	0	0	0	0
	Independent	0	0	0	0	0
Subtotal number of messages		1	3	4	0	2
Unit 5	Explicit	1	0	1	1	1
	Implicit	0	0	0	0	0
	Independent	0	0	0	0	0
Subtotal number of messages		1	0	1	1	1
Total number of messages		4	6	7	4	8

Note. Explicit = a direct response to or comment on a specific message/student.
Implicit = an indirect response or comment in which the content of another student's message was mentioned, but not that person's name.
Independent = a message stood alone without referring to any other messages/students, or a message that answered the discussion question.
"No interaction" pattern = "0 0 *X*" (*X* refers to any number).
"One interaction" pattern = "1 0 *X*", and "0 1 *X*" (*X* refers to any number).
"Two interactions" pattern = "2 0 *X*", "1 1 *X*", and "0 2 *X*" (*X* refers to any number).
"Above two interactions" pattern = patterns not belonging to "no interaction", "one interaction", and "two interactions."

Table 8 displays the interaction patterns exhibited by all students in Class A and Class B. Students in each class exhibited a variety of interaction patterns, including: (a) no interaction, (b) one interaction, (c) two interactions, and (d) above two interactions. A comparison of the two classes shows several instances where the average number of interaction patterns exhibited by the students differed. The average number of times students in Class A exhibited a no interaction pattern was 2, whereas for students in Class B, it was 1.2. The average number of times students in Class A exhibited a one interaction pattern was 1.2, whereas for students in Class B, it was 2.8. The average number of times students in Class A exhibited a two interactions pattern was 0.6, whereas for students in Class B, it was 0.6 also. The average number of times students in Class A exhibited an above two interactions pattern was 2.2, whereas for students in Class B, it was 0.4.

Table 8 shows that all students in both classes had at least two interactions with peers with the exception of two persons in Class B: Ivan (in the High IO group) and Jack (in the Low IO group). Because Class B required fewer postings, there were fewer students in this class than Class A who exhibited patterns of two interactions and above two interactions.

In Class A, there were differences between the High IO group and the Medium and Low IO groups. More students in the High IO group than the other groups exhibited the no interaction pattern. Fewer students in the High IO group than the other groups exhibited the two interactions and above two interactions patterns. The observations therefore indicate that difficulties discussed above tended to affect High IO group's

interaction with others in Class A.

In Class B, there seemed to be no difference between the High IO and the Low IO group. Due to the low requirements (a minimum of one posting for the co-facilitators and no specific number of postings for discussion participants), students could receive full participation or co-facilitation credit on this component of online discussion without interacting with too many people. This fact could also explain the tendency of more students in Class B than Class A to exhibit the one interaction pattern.

This section reported the different interaction patterns exhibited by all interviewees in order to determine the impact of those difficulties contributing to their perceptions of IO on online interaction with others. The results indicated that those difficulties might influence those interviewees' interaction with others in online discussions.

Table 8

Number of Times Each Interaction Pattern Was Exhibited by Interviewees

Student	IO Group	Type of Interaction Pattern			
		No Interaction	One Interaction	Two Interactions	Above Two Interactions
Class A					
Alan	high	3	2	0	1
Doris	high	3	1	0	2
Frances	medium	2	0	0	4
Grace	medium	1	2	2	1
Eric	low	1	1	1	3
Average		2	1.2	0.6	2.2
Class B					
Ivan	high	1	4	0	0
Kevin	high	2	1	1	1
Helen	low	1	3	0	1
Jack	low	2	3	0	0
Lily	low	0	3	2	0
Average		1.2	2.8	0.6	0.4

Note. Interaction patterns were identified using data in Tables 6 and 7 as follows:
"No interaction" pattern = "0 0 *X*" (*X* refers to any number).
"One interaction" pattern = "1 0 *X*," and "0 1 *X*" (*X* refers to any number).
"Two interaction" pattern = "2 0 *X*," "1 1 *X*," and "0 2 *X*" (*X* refers to any number).
"Above two interactions" pattern = patterns not belonging to "no interaction," "one interaction," and "two interactions."

Learning Strategies to Engage in Quality Learning

This section reports the findings relevant to the fourth research question: What strategies do students employ to avoid or manage those difficulties and engage in quality learning (defined as learning that is achievable by deep reflective thinking and interaction with others)? Students who engaged in deep processing were those whose depth of processing ratio was beyond 0.70. Students who engaged in active learning through interaction with others were those who exhibited the pattern of two interactions or above two interactions. I investigated students' learning strategies in an attempt to answer question four. Table 9 shows that only Alan, Doris, Frances (Class A), and Kevin (Class B) met the necessary criteria for identification as students engaged in quality learning.

Students used a variety of strategies to deal with those difficulties contributing to their perceptions of IO as they engaged in quality learning. I have organized these strategies into 7 categories: (a) online class preparation strategies, (b) strategies to identify relevant information, (c) strategies to process online information, (d) strategies to process printed materials, (e) strategies to keep learning on track, (f) strategies to organize learning, and (g) strategies to avoid internal and external distractions.

Table 9

Overview of Interviewees' Interaction Patterns and Depth of Processing Ratios

Student	IO Group	Type of Interaction Pattern				Depth of Processing Ratio
		No Interaction	One Interaction	Two Interactions	Above Two Interactions	
Class A						
**Alan	high	3	2	0	1	1.00
**Doris	high	3	1	0	2	0.75
**Frances	medium	2	0	0	4	0.82
Grace	medium	1	2	2	1	0.43
Eric	low	1	1	1	3	0.31
Class B						
Ivan	high	1	4	0	0	0.50
**Kevin	high	2	1	1	1	1.00
Helen	low	1	3	0	1	0.56
Jack	low	2	3	0	0	0.43
Lily	low	0	3	2	0	0.33

Note. ** indicates those who met the necessary criteria (i.e., the depth of processing ratio was beyond 0.70 and a pattern of two interactions or above two interactions was exhibited) for identification as students engaged in quality learning.

Online Class Preparation Strategies

A CMC learning environment requires that students possess both the ability to deal with the course subject matter, as well as the technical skills to accomplish CMC tasks. Common tasks in CMC include online interaction with peers and the instructor, and online fulfillment of the course requirements. Students adopted various strategies as a means of becoming prepared for content learning. Those strategies included several approaches to resolving technological problems, becoming familiar with how the course was structured, and performing the various CMC tasks.

Alan, Frances, and Kevin were experienced technology users; they reported that they did not have problems using the software. Even when they encountered technological problems, they could resolve them independently by consulting online software manuals or in Class A by using the “Help” conference in FirstClass computer conferencing. In the “Help” conference, students helped each other resolve problems involved in conducting Web searches, operating FirstClass, locating materials in the library and online databases, and writing academic papers in the workspace. The students in both classes also reflected that the orientation session helped them a great deal both in understanding the syllabus and in solving technical problems.

> Alan: Adjusting to online interaction, connecting, and learning the software were not problems for me. This is primarily because I work with computers and networking a lot. However, having a "Technical Help" area in an online course seems to have helped other students. Understanding the syllabus is immensely helped by a face to face orientation.…I used help files, other students, and the instructor (usually in that order) whenever I didn't understand something about the software. (Class A, e-mail)

> Frances: I really like working in FirstClass. It is very user friendly.…In orientation, Dr. E had experienced FC users sit next to new FC users. We went through various practices to become acclimated to it.…I never had difficulty with FC. The one question I did have I asked the person who put himself down as the "expert" in the class HELP folder [“Help” conference in FirstClass]. (Class A, e-mail)

On the other hand, Doris was an inexperienced technology user. She encountered a connection problem at the beginning of the semester. She asked for the instructor’s help in resolving the problem at the orientation session. Much like the other students, she suggested that the technical training provided in this session was helpful. She learned the functions of FirstClass at that time and then practiced those functions at home. Through trial and error, she learned enough about the basic functions to be able to do the work required for the class. She also remarked that she found one computer expert in the class whom could ask for help if there were technical problems that she could not solve by herself.

> Doris: Well, actually I solved the problem before the first unit. At the beginning I felt frustrated, I felt a little bit scared, but it is ok now.…Dr. E explained those icons at the orientation. And then I just tried and tried. I just trial and errors. If I can not work that kind of function, I just gave up. Because I know the basic functions, to enter and to post. I just use those. I have a group mate, one of our group mates is the computer teacher. If I need help, I will ask him. (Class A, f2f)

Doris, Kevin, and Frances were novice online learners. They spent a bit of time at the beginning getting familiar with how their courses were structured and how to perform the various CMC tasks. Doris explained that because she was uncomfortable reading from the computer screen, she printed out all syllabi from the course website and read them carefully before the orientation meeting. She noted that the course website was confusing to her at first. Yet, she asked questions of her peers and the instructor in

order to clear up her confusion.

> Doris: Actually I am not comfortable…reading some contents on [the] computer monitor, so I just print out everything, every syllabus, every every contents about the assignments, I just print out everything, and read them. If I have something to ask, I just e-mail to the professor. Before the class begins, the professor contacted me first, so I knew already her e-mail.…It [the course website] was confusing to me…the first time [I accessed it]. But I just asked [for] another student's help. Even he didn't know that. So I just asked Dr. E directly. (Class A, f2f)

Kevin indicated that he learned how to perform the CMC tasks by observing what other people did. His computer competence gave him confidence in his ability to complete the tasks.

> Kevin: I have concerns about doing the article review and the Web Board and all that kind of stuff. But since I teach computer related courses, it's in my logic that I can do that.…Because I am a visual learner, once I see, I know how to do it. (Class B, f2f)

Frances responded that the course website and the instructions in the syllabi were very clear and that the software was easy to use. She did not feel that the online environment required any special period of adjustment: "You pretty much have to immerse yourself into it just as you would have to do with any other new environment. If you still cannot figure something out, there is always a fellow classmate who will help" (Class A, e-mail).

Strategies to Identify Relevant Information

Students developed strategies to identify the most relevant information out of the voluminous material they had to deal with in the course due to the frequent ongoing online discussions and the seemingly endless resources on the Web. Those strategies included: (a) identify messages that dealt with personal interests, or commentary

involving different perspectives or contradictories; (b) identify which students usually posted more meaningful messages, and (c) identify materials to study based on their relevance to personal interests or to fulfilling the course requirements.

Students such as Frances, who had no problem keeping up with online discussions, logged on to the conferencing system several times a day and read messages when they came in: “I open FC multiple times during the day and read the posted messages so as not to get behind” (Class A, e-mail). On the other hand, some students, such as Alan, Kevin, and Doris, were unable to read all messages and could not help but select some on which to focus. Alan and Kevin (who were native English-speakers) quickly skimmed all the messages and then read carefully only those that interested them. They identified as worthy of attention those messages that dealt with their personal interests, offered different perspectives, or contradicted stated information. They usually skipped the rest of the messages. Kevin noted that some messages were just general reactions or repeated information.

> Kevin: I skimmed them [the messages] quite quickly. If I am interested, I will read them. If I found one I was interested [in], I will read…[every message] related to it.…Basically it [the Web Board discussion] gives generally reactions.…The online discussions really should kind of stream from your readings. It's [a] kind of general conversation. That's why sometimes it gets off task. Some of the messages…I know I don't have to read because they are related to the same topics. If that's interesting to me, I will pick that. If there is something contradicting to what I already know, I will read that, or if I have different ideas.…I usually just take one person and try to get into the conversation. (Class B, f2f)

Doris, who was a non-native English-speaker, was not able to skim messages quickly. At first, she tried to read all the messages. She gradually discovered that certain students usually posted more meaningful messages, making contributions that were more

valuable or relevant to the subject matter. Later on, she just read those students' messages.

> Doris: First of all, I tried to read all answers to the questions.…During the semester, going through the discussions, I noticed some people know a lot [more] than the other persons, or have more ideas [about the course material]. And some make more critical replies. So I just followed those persons. (Class A, f2f)

After they determined which messages they wanted to read, generally the students followed a single thread of messages in order to avoid getting distracted by discussions of other topics.

The seemingly infinite resources on the Web were a challenge to almost every student. Students identified as relevant for study those materials that related to their personal interests or that had direct bearing on fulfilling the requirements of the course. Other common strategies used to distinguish more important from less important material included highlighting and referring to the learning objectives set for each unit.

Alan and Doris selected materials according to the relevance of the content to the fulfillment of the course requirements. First, they referred to introductions, overviews, and learning objectives for the units in order to gain a general understanding of the material and to identify specific material on which to focus. Then, they referred to assignments, such as the discussion questions, to determine which materials to study. If time permitted, they also selected materials in terms of their personal interests.

> Alan: I read the discussion questions first, then typically read the abstracts or introductions of all the readings, so I know generally what they are about. I go back and read entire articles that pertain directly to the discussion questions. I usually skim the other readings, but usually do not spend too much time on the extra resources, unless they are of particular interest. (Class A, e-mail)

> Doris: [Pointing to the course website] I actually I almost read all this, it is not here anymore. Before Dr. E revised the pages, there are some summaries here. I read all the summaries about the units.
>
> Interviewer: Where?
>
> Doris: Dr. E removed that. A summary of the whole unit, a lecture something like that. There is not much explanation [provided], just [a] kind of outline, so I can…[get a] rough outline of the unit. I can realize what I should know and what concepts are important to learn. So I just read that first before everything. And then I read the background, and objectives.…Then, I decide which articles to read after I see the discussion questions. I read the articles related to the questions first, and then the other things if I have time. (Class A, f2f)

Kevin selected materials in terms of the relevance of the content to his personal interests. In particular, he identified those materials that would be helpful to his dissertation work (at that time, he was writing his dissertation proposal). In addition to highlighting, he made outlines to help him identify the main ideas in the material.

> Kevin: I chunk it out sometimes. I might highlight and narrow down to four or five bullets in an outline form to see what [main ideas are] actually there. And every once in a while, I look for materials from the Internet or the library, if they [required texts] are talking about somebody's research. I usually skimmed them and some of them I might [find] interest[ing] because they may relate to my dissertation. (Class B, f2f)

Frances gave all materials equal attention. She usually finished reading all the required texts. If she had time, she would also read some of the supplemental readings.

> Frances: Since there are so many resources that are provided, I have still not figured out how to get through all of them. There are just so many! I just read as many as I can because they are all relevant. It is sometimes time consuming just to get through required readings let alone supplemental readings. (Class A, e-mail)

Strategies to Process Online Information

Students who were comfortable reading information from a computer screen had developed strategies for processing discussion messages in computer conferencing and online documents on the course website. Experienced technology users, such as Alan and Kevin, tended to utilize more system capabilities in order to process online information more effectively.

Students used distinctive ways of dealing with conference messages, including the “messages summarize” function in FirstClass, reading all messages daily, printing out messages, and forwording messages to a personal e-mail account. For example, Alan initially found it difficult to keep up-to-date with all the conference messages because he felt he was too busy to read the messages every day. Subsequently, whenever he got online, several messages had accumulated for him to read. Alan also felt that the numerous short messages hindered navigation, making it difficult for him to use his time efficiently. Alan’s situation improved when he discovered the “messages summarize” feature offered by FirstClass. This feature helped him navigate threaded messages more effectively in this online course (his sixth). He reflected that this function was so helpful he wished he had discovered it earlier. He utilized this summarizing feature for unread messages, taking each conversation (thread) separately to avoid getting distracted by discussions of other topics. This “messages summarize” function generated a document compiling all selected messages sorted by subject, or discussion topics. As a result, Alan could read or skim this document instead of having to open several messages. While processing this document, Alan determined which conversation he would like to

participate in and then replied to it. He explained that he could not participate in every conversation due to his limited time.

> Alan: I now usually use the summarize feature on unread articles [messages], taking each major thread separately. After reading I respond to the thread if I feel like doing so. After I have finished contributing, I usually don't read any more threads other than responses to things I wrote, or other threads that are interesting. (Class A, e-mail)

Frances read conference messages every day so as not to get behind. She processed online communications in the sequence in which the contributors posted them: "My strategy is to read through the messages in the order they were posted to follow the flow of the discussion. It is usually pretty easy to keep up" (Class A, e-mail).

Doris preferred to print out messages (unless the messages were very short) to assist her when composing responses. When processing information online, she sometimes felt disoriented by multiple conference spaces and was confused by the threading structure of messages (unlike Web Board, FirstClass does not support multiple level threads). Doris closed irrelevant subfolders to avoid confusion and limited the number of subfolders open on the desktop.

Kevin did not like processing conference messages in Web Board. There were two major reasons. First, he felt other messages on the board were distracting and therefore forwarded the board messages to his personal e-mailing system. He then read and responded to discussion messages using his personal e-mailing system. Furthermore, he managed those messages using the e-mailing system's capabilities (for example, organizing the messages into different folders and marking important messages in the inbox area as a reminder to himself). Second, he reflected that he preferred messages

sorted by date (which is how the e-mailing system structures messages), not by topic (which is how Web Board structures messages). Kevin could not explain why, but he felt that sorting by date was more structured. Whereas the conferencing system itself placed constraints on the ways Alan could process the online information, he found an alternative approach that fitted his learning preferences.

Students developed several different strategies for processing online documents on the course website. Alan, Frances, and Kevin frequently used Word processing software to help them take notes electronically. They highlighted the numberal texts, copied them, and then pasted them into a Word document and edited their notes there. Unless it was a file in PDF format, they enjoyed editing texts electronically.

> Kevin: Sometimes what I will do is like she has that on the web, I just highlight it all and copy it and put it in a word document and then I edited it and reword it. In that way I can edit it when I need to. I usually put them [my notes] into an outline form like one, two, three, four, five. (Class B, f2f)

While trying to locate the desired online document to process, students sometimes experienced disorientation. Alan, Frances, and Kevin employed certain system capabilities in order to navigate and/or manage Web resources effectively and avoid disorientation. Alan utilized a “threaded window” approach by right clicking on a link and choosing “open in a new window.” He remarked, “That way I can quickly creep back up, and I typically don't open more than three links deep, unless I feel I am getting closer to the information I seek” (Class A, e-mail).

Frances saved and managed links on her local hard drive for later retrieval. Kevin created a personal website to manage Web resources: “I also create pages on my own

website; it’s like bookmarks in my html” (Class B, f2f).

To avoid disorientation, Frances and Kevin learned not to go more than three links deep unless they felt they were getting closer to the desired information. Bookmark and search functions were the most common browser capabilities they used to help them minimize the problem of disorientation. Doris indicated that she quit when she felt she was lost or else kept clicking on the “back” function offered by the Web browser to get back to somewhere that was familiar to her.

Strategies to Process Printed Materials

Students adopted several strategies that they had used in on-site classroom learning to help them process printed materials. Highlighting and note-taking were the most common strategies. Highlighting was a strategy used by all students. When they read through articles, they highlighted important keywords, definitions, and ideas. Through highlighting, they were able to remember the important parts of the articles and to obtain an overview of the material they were learning.

Taking notes was another strategy used by some students. Doris was not comfortable reading material from a computer screen, so she printed out almost everything to study. Doris showed me her notes and described her note-taking techniques in detail. Although she found note-taking to be time-consuming, she reported that the process increased her understanding of the course material and saved her time later. When it came time for her to answer the questions or write a paper, she didn't have to go through the articles again. She just referred to her notes.

Doris related her note-taking process to me step by step. First, Doris employed an

outlining strategy in order to sketch out an overview of the contents and to identify major concepts.

> Doris: At first, I will read carefully the overview or abstract or introduction, and then I can get what the author tries to tell, what's the goal of this paper. Then I go through the headings, so I can make some kinds of outline. And then just read everything. I will highlight important parts that I want to remember. I make separate summary by myself. (Class A, f2f)

For the purposes of practicing her English, she also copied some sentences associated with the concepts into her outline.

> Doris: Well, actually when I read XXX [her first language] articles, I just wrote a very short note, just very short sentences or part of sentences or just sometimes just one word something like that. But in English, I should write whole sentences, not a whole paragraph, just some kinds of who's telling what, or what's the basic concepts of this part, something like that….Sometimes I just write the whole sentence because I can use it as a reference, not an academic reference, just for me to write English, just practice writing English. (Class A, f2f)

She then organized those concepts to help her understand them.

> Doris: Here is the subtitle, then I divided some key concepts within this part, I re-organize the contents according to my needs, so….It is easy for me to read this one [note] and to remember the contents. (Class A, f2f)

Her outlines referred to all of the required texts for the given unit (summarized in different colors).

> Interviewer: How do you organize your notes? By unit or by article?
>
> Doris: By an article and unit, so…like this one. Every article relates to the unit and then put a summary for that. In that case, I just choose the required readings, then I make a thorough, very careful summary for that unit, then just add with another color pen [when add another article into this summary].
>
> Interviewer: Oh, after that if you find some articles relate to that unit, you will put new ideas with color pen that you get from extra articles into that note.

> Doris: Yeah. That helps but also takes much time. Anyway, because my bachelor is literature and has nothing to do with education. (Class A, f2f)

Strategies to Keep Learning on Track

Several strategies were used by students to keep learning on track, such as looking at peers' assignments, finding learning partners, and interacting with peers online. Some students evaluated whether their learning was on track by observing other fellow students' assignments. Kevin explained that assignments and Web Board discussions were devices that were helpful in keeping him on track. If the ideas of peers appearing in assignments or in online discussions were different or contradictory to his ideas, he went back to the contents and reread the relevant parts again, or he replied to a particular message to discuss the differences.

> Kevin: For me, because I am a slow reader, it's entirely too much to do in one semester. However, going back and reading what other people's… [assignments], I will go back over here and look at the other articles. I go back and read other people's work. I read their stuff and they give me ideas and they help to keep me on track. They keep me on track if I have totally different opinions. (Class B, f2f)

> Kevin: For the Web Board comes in, the conversation becomes casual, and less professional, that's easier to understand, so it's easier to visualize what's going on. (Class B, f2f)

Sometimes, students found learning partners with whom they could discuss difficulties, ask questions, and exchange ideas. After discussing these matters with peers, they paraphrased the contents in their own words and got feedback from the other students to achieve understanding. For example, when Kevin could not understand something on his own, he consulted with learning partners on the phone, in person, or by e-mail.

> Kevin: Sometimes I e-mail people. “What do you think about this?” “How do you go about the article?” Our group is pretty good at e-mailing each other back and forth. People who are taking courses online need to have somebody to communicate with, to get their input. (Class B, f2f)

> Kevin: Sometimes reading the articles is very, I want to say, flat because you reach that information but I don't really see it. So when I hear somebody else's talking about it…[for example] because Mary is in my class…occasionally we talked about the articles. What do you think about that? I get the feedback that I can't necessary get out from the article myself. (Class B, f2f)

When Frances commented on how to keep on the right track in this learning environment, her reflections were similar to Kevin’s. She suggested trying to interact more with peers online so as to learn from them.

> Frances: You probably need to start posting more of your ideas so you can get feedback from your peers. This type of environment supports collaborative learning, so I guess the best way to understand this environment is to be immersed in it. (Class A, e-mail)

Strategies to Organize Learning

Compared with on-site classroom learning, most students found online learning difficult to organize. There were several reasons for this response. Usually, busy people who have tight schedules choose this type of asynchronous class because it offers the advantage of time flexibility, allowing them to arrange their own schedule to “go to class.” Nonetheless, as this study shows, online classes present their own challenges. Students’ job and/or family responsibilities can interfere with course work; the online courses that students in this study took required continual attendance for a week during online discussions. Novice learners need special help organizing this kind of learning. When novice learners in this study did not get such help, they felt overwhelmed. Finally, students’ other learning commitments can interfere. Students in this study who took an

additional online course (which also required continual input during a week) had difficulty organizing their learning.

Some of the common strategies used by students for organizing learning included the following: setting up a study plan for doing course work online and offline, creating a personal calendar, and using the unit syllabus as a tracking system to keep up with the pace of instruction. Both Alan and Kevin were employed full-time. Alan was taking another online course at the same time, whereas Kevin was a full-time graduate student. Both of them not only set up a study plan to organize their learning, but also created a personal calendar to keep track of upcoming assignments. Alan devoted all his nights to studying.

> Alan: I usually spend 3 nights a week on the readings….[I]t is hard to get on[line] every night when you have multiple classes. WE have so much to do in this class.
>
> Interviewer: 3 nights a week on the readings, just for this class?
>
> Alan: Yes, I usually spend 2–3 hours a night, 5–6 days a week on course work, about half on line, about half reading. (Class A, e-mail)
>
> Alan: I…still do not feel organized! Having a calendar with me at all times helps. It also helps to organize materials before going online, having them nearby, and to prepare a list of the things I will need to do when I get online, then add to that list as I read announcements, etc. (Class A, e-mail)

Kevin's study plan was slightly different; he worked on both his job and schoolwork interchangeably during the week and devoted the weekends to his schoolwork.

> Kevin: It used to drive me crazy. I am still struggling….I keep a calendar, write things in a piece of paper. I have a notepad…[I use for] writing [down] things I need to finish. I have a calendar in my computer. I have several calendars. Maybe my work schedule interferes with it [my work in the course] because I teach three classes at college. So I have a full schedule. And…[I get confused] because everything is not due on the

> same day. So usually Saturday afternoon or Sunday I start to catch [up on] all my school work as much as possible, especially for Dr. M's class because it's all on the web and all due by Monday. (Class B, f2f)

Doris and Frances felt more organized in their online learning, probably because their study time was not as limited as Alan's and Kevin's. They also set up a daily study plan. They both indicated that they did not need any calendar as other people did. They just printed out the unit syllabus as a tracking system to help them keep up with the instructions. The instructors in both classes organized the unit syllabus generally by learning objectives and learning activities, or assignments. The part of learning activities contained instructions about the due dates, requirements and assessing criteria. They made a check mark in the margin of the paragraph describing the deadline and requirements for an assignment whenever they completed it.

> Frances: I print out the assignments at the beginning of each unit and make sure that I write down when things are due. I check off things that need to be done for each unit on the unit printout, so I don't miss anything.…Dr. E has written out exactly what we have to have done by what day. This helps me to stay on schedule. It is very helpful for a new student to online learning. (Class A, e-mail)

Strategies to Avoid Internal and External Distractions

Job-related time constraints, personal characteristics, and/or family obligations distracted students. Consequently, some students adopted strategies for avoiding internal and external distractions. With limited study time due to his job-related time constraints, Alan was aware of the potential for internal distractions such as anxiety and stress. To avoid these distractions, he set a schedule for study and completely focused on his study during scheduled study time. In order to maintain his regular life, he adhered to the schedule even if he could not finish schoolwork in the time allotted.

> Alan: I give classes the time that I have, usually about 2–3 hours per night, which is not enough, but is all I have. I do the best I can with that time, and try not to stress about work I haven't finished or stay up too late, because it affects other areas of my life. Also I limit myself to 6 credit hours per semester, as I also work full time. (Class A, e-mail)

Kevin understood that if he became frustrated when he struggled with something, his brain would shut down. He was also aware of his ability to multitask. He took advantage of this characteristic to reduce the possibility of frustration and to ease his progress through the course.

> Kevin: Usually I don't work [on] one thing at a time, maybe two maybe three [things]. I feel [I get] more done if I am not doing just one thing.… My brain switches back and forth. If I start to focus on one thing, what happens is when I struggle with something, I will end up with frustration and don't want to do anything else.…I work on my technology job. I am doing my e-mail, skimming stuff and searching the Internet. I am doing all those things at the same time, not simultaneously but just a little chunk. I have some characteristics of multitasking, or [I am a] hyper-acting kind of person, I cannot stand still. So I do lots of work at the same time. (Class B, f2f)

Doris was aware of possible external distractions coming from family obligations. She was a housewife and had two boys. Doris went to the library to study after sending her children to school. She responded that studying in the library made her concentrate better. She performed most tasks demanding cognitive effort—reading assignments, taking notes, and composing messages—in the library. When at home, she did things requiring less cognitive engagement, such as posting messages or printing out materials.

> Doris: I divided some time that I can study in a day. So I can come to school during my boys are in their school. So maybe from 9 o'clock to 2 o'clock in the afternoon, I can read some materials. And if I have something to post or something to reply or something to make for this class, then I do that at home. Because I need some kinds of concentration to read and to write, I did those things in [the] library without my kids. After they come back from school, I just post or print out or make some

things. (Class A, f2f)

In summary, Alan, Doris, Frances, and Kevin used a variety of strategies in dealing with the difficulties that contributed to their perceptions of IO and, as a result, were able to engage in quality learning. The strategies that they used are summarized by category in Table 10. Those categories are online class preparation strategies, strategies to identify relevant information, strategies to process online information, strategies to process printed materials, strategies to keep learning on track, strategies to organize learning, and strategies to avoid internal and external distractions.

Table 10

Learning Strategies to Succeed in Your Online Course

Category	Strategies
Online class preparation strategies	<u>Resolve technological problems:</u> 1. Consult online software manuals. 2. Consult "Help" or the Q&A conference provided by the class. 3. Ask friends or the instructor for help. <u>Become familiar with how the course was structured and how to perform the various CMC tasks:</u> 4. Become familiar with and identify any questions/problems from the course structure and the syllabus before the orientation session. 5. Attend the orientation session in order to understand the course structure and the syllabus, obtain necessary technical skills, and resolve any questions/problems. Orientation results in a readiness for content learning. 6. Practice working in the online environment. 7. Ask or observe peers online when unsure how to do a task.

Table 10 (Continued)

Category	Strategies
Strategies to Identify Relevant Information	<u>When unable to keep up with the online discussions:</u> 1. Identify messages to read that deal with personal interests, or commentary involving different perspectives or contradictories. 2. Identify which students usually post more meaningful messages and learn from them. <u>When unable to discern relevant materials to study:</u> 3. Refer to introductions, overviews, and learning objectives for the units in order to gain a general understanding of the materials and to identify specific materials on which to focus. Then, refer to assignments to determine which materials to study.
Strategies to Process Online Information	<u>Process information in computer conferencing:</u> 1. Use the “message summarize” feature offered by FirstClass for unread messages, taking each major thread separately. 2. Close irrelevant subfolders or limit the number of subfolders open in FirstClass to avoid confusion. 3. Forward discussion messages to a personal e-mailing system, if unaccustomed to reading messages in computer conferencing. And manage messages there by using functions of the e-mailing system that are familiar. <u>Process information on the course website:</u> 4. Copy all numberal texts (unless in PDF format), and then paste them into a Word document for editing or taking notes. 5. Employ the “search” function of the browser help to locate the desired information. 6. Utilize a “threaded window” approach by right clicking on a link and choosing “open in a new window” to return quickly to the original place. 7. Avoid going more than three links deep in order to prevent disorientation, unless the information sought is near at hand. 8. Create a personal website, use the “bookmark” function of the browser, or save and manage links on your local hard disk to manage Web resources. 9. Return to the original place by using the “back” function when lost. 10. Quit when completely lost and restart again later.

Table 10 (Continued)

Category	Strategies
Strategies to Process Printed Materials	1. Highlight important keywords, definitions, and ideas when reading articles in order to help remember the important parts and obtain an overview. 2. Apply note-taking skills acquired in on-site classroom learning. Although time-consuming, the process of note-taking enhances understanding and saves time later on when doing assignments.
Strategies to Keep Learning on Track	1. Look at peers' assignments. 2. Find learning partners. Consult or discuss with them on the phone, in person, or by e-mail to help understand any difficult materials. 3. Interact with peers in online discussions and learn from them.
Strategies to Organize Learning	1. Set up a study plan for doing course work online and offline. 2. Create a personal calendar to keep track of upcoming assignments. Or print out the unit syllabus containing assignment due dates and requirements as a tracking system to help keep up with the pace of instruction.
Strategies to Avoid Internal and External Distractions	1. Set up a schedule for study and completely focus on studying during the time allotted. Adhere to this schedule and try not to stay up too late or to become stressed out about unfinished work. 2. Manage one's personal emotional status (and keep on track in the course) by reducing the potential for frustration or anxiety. 3. Avoid external distractions (stemming from job and/or family obligations) by finding a suitable place—such as a library—for concentrating on studying.

Summary

This chapter presented the findings of my study. I began this chapter by outlining the distinctions between interviewees, addressing their reported readiness for learning in the current online course (based on their answers to the questionnaire), and perceived information load (as revealed in interviews). Second, I reported the difficulties the interviewees encountered that contributed to their perceptions of IO from their learning experiences in the online class they were taking. Those difficulties included (a) connection problems, (b) navigation difficulties, (c) discomfort with online communication, (d) numerous ongoing discussion messages and endless resources, (e) difficulty in organizing learning, and (f) problems understanding the assigned readings. Subsequently, a model of online students' perceptions of IO was proposed to illuminate the phenomenon of IO in educational CMC. Third, I reported the findings of how those difficulties affected those interviewees' learning in online discussions. The results indicated that those difficulties might influence the interviewees' interaction with others, but did not influence their deep level of information processing. Finally, I identified a variety of strategies the interviewees used for avoiding or managing IO to engage in quality learning. Those strategies were: (a) online class preparation strategies, (b) strategies to identify relevant information, (c) strategies to process online information, (d) strategies to process printed materials, (e) strategies to keep learning on track, (f) strategies to organize learning, and (g) strategies to avoid internal and external distractions.

CHAPTER V

SUMMARY, DISCUSSION, AND CONCLUSIONS

This chapter consists of three sections: (a) a summary and discussion of the findings of this study, (b) implications for course design, and (c) recommendations for future research. The purposes of this study included the following: (a) to understand the difficulties students encounter that contribute to their perceptions of IO in CMC, (b) to observe the impact of those difficulties on students' levels of information processing and interaction with others in online discussions, and (c) to identify students' strategies for avoiding or managing those difficulties in order to engage in quality learning. The following questions guided this study:

1. When they learn through the medium of CMC, what difficulties do students experience that contribute to their perceptions of information overload?
2. Do those difficulties affect students' levels of information processing (surface or deep processing) as observed in their discussion messages?
3. Do those difficulties affect students' interaction with others in online discussions?
4. What strategies do students employ to avoid or manage those difficulties and engage in quality learning (defined as learning that is achievable by deep reflective thinking and interaction with others)?

Summary and Discussion

To date, researchers have paid little attention to the problem of IO—more specifically, to its impact on students' quality interaction—in educational CMC. The present study has attempted to fill that gap by providing a holistic and in-depth

understanding of this phenomenon in online education. Investigating IO was a challenge. IO is a complex phenomenon that is usually not the result of just one variable, but a mixture of several variables. In addition to the quantitative and qualitative components of information related to IO, the study had to take into account variables related to the specific students and learning situations being examined. By understanding the particular variables that cause IO for each student, online educators may be able to alleviate students' consequent difficulties. The findings of the present study suggested that students' metacognitive awareness and the structure of the course tended to influence the effects of IO on their learning.

The findings of this study shed light on several issues. They consist of: (a) issues related to students' readiness for online courses; (b) issues related to medium interface; (c) issues related to different learning style preferences and adaptation; (d) issues related to information selection; (e) issues related to time management; (f) factors that affect online students' deep processing; (g) factors that affect online students' interaction; and (h) the importance of metacognitive strategies to online students.

Issues Related to Students' Readiness for Online Courses

As Murphy and Cifuentes (2001) suggested, the orientation session served as an opportunity for students to solve technological problems and get ready for content learning. The only student for whom this was not the case was Ivan (Class B). Connection problems at the beginning of the semester (specifically, a firewall problem and the fact that he did not have an Internet connection at home) meant it took him almost two weeks to get prepared for content learning. Ivan's situation was complicated

by the fact that there was a greater amount of assigned reading in the first week than in the following weeks. Ivan felt he could not keep up with the pace of the class and grew very frustrated. With the instructor's encouragement via email, Ivan stopped thinking about dropping out of the course. He completed the course successfully.

Ivan's case offers some considerations for online instructors. First, the instructor's encouragement and support are crucial in easing students' frustration and anxiety and in motivating them to learn. Second, the orientation session may not be sufficient to prepare students for learning. They may require more time to become familiar with the online environment. The literature suggests that students' comfort levels in online courses are connected to the amount of time they have to prepare; two weeks is the period of time recommended by most student participants in Conrad's (2000) study for sufficient preparation. It may be pedagogically advantageous to arrange for courses to begin a week or so before their official start date (Conrad). Third, in order to give students enough time to resolve technological problems, the workload at the beginning of the course should not be too demanding.

Issues Related to Medium Interface

Most students participating in the present study found the threading structure of computer conferencing and the hypertext system of the course website difficult to navigate. Other studies confirm this finding (Edwards & Hardman, 1989; Harasim, 1990; Hiltz & Turoff, 1985). Besides the two confounding variables (technical skills for participating in CMC and efficiency in reading from computer screens), the interfaces of the computer conferencing software programs and the Web imposed a seemingly undue

burden on students and distracted them from the process of learning.

The literature is unclear on the effects that navigation difficulties in computer conferencing have on learning. However, the cognitive load theory, which was developed by Sweller et al. (1998) to reduce cognitive load in traditional classroom instructions, may offer some insight. The cognitive demands of the threading structure of computer conferencing—particularly the fragmentation of information caused by the non-linear discussion format and the redundancy of information caused by the asynchronous attribute of the medium and students' interactions for grades—were evident to most students in both classes. First, fragmented information creates a "split-attention effect." This effect, proposed by Sweller et al. (p. 277), refers to the idea that the capacity of working memory can be reduced when integrating disparate sources of information. The split-attention effect may occur in computer conferencing when students have to integrate messages from different contributors regarding different topics. Off-topic discussions—when the line of discussion loses its coherence—make it more difficult to link messages belonging to a particular topic. Second, redundant information corresponds to the "redundancy effect" (Sweller et al., p. 283). The redundancy effect refers to the idea that redundant information reduces the capacity of working memory. Sweller et al. conducted several empirical studies in classroom settings and found evidence that both the split-attention effect and the redundancy effect influenced students' comprehension. Further research can be conducted to determine the extent to which those effects influence students' learning in computer conferencing.

Students' consistent reflections regarding the levels of interface layers may have

implications for interface design. In particular, they may suggest ways that improved design can help avoid the disorientation that is produced by hypertext systems and computer conferencing. Disorientation caused by Web resources were evident to the students in both classes who participated in this study. The literature suggests consistently that navigation difficulties are inevitable when users browse hypertext systems (Edwards & Hardman, 1989). Alan (Class A) and Kevin (Class B)—both of whom possessed a high level of computer competence—indicated that in their personal experience, people got confused easily when the hypertext structure was organized more than three levels deep. Similarly, other students participating in the present study remarked that they preferred a linear as opposed to a non-linear style for browsing Web pages. When the number of interface layers exceeds three levels, users may feel that the information is structured non-linearly and is fragmentary.

As for disorientation associated with the FirstClass computer conferencing system, some students indicated that they did not like the sub-conferences within conferences. As Alan noted: “Sometimes it’s hard to tell where the ‘action’ is if the discussion conference is more than 2 levels deep.” However, those difficulties associated with disorientation did not bother students as much as the cognitive load produced by the threading structure of computer conferencing. Students seemed to get used to disorientation and developed different strategies for coping with it.

Issues Related to Different Learning Style Preferences and Adaptation

The present study identified three learners (each with different learning style preferences) who were not comfortable with the text-based-only format of their online course. Doris' (Class A) first language was not English. She preferred to take more time than the other students to read and compose offline because she was worried about making mistakes in her English writing and having them posted publicly where her American counterparts would see them. Students who are non-native English speakers need to be reassured that everyone makes minor mistakes in conference messages and that this is not important as long as the author's meaning is conveyed clearly (Salmon, 2000).

Ivan (Class B) preferred on-site classroom discussions to online discussions. He considered online discussions too time-consuming due to his lack of efficiency in reading from computer screens, poor typing skills, and limited computer skills. These are all weaknesses that can be conquered with practice. Students simply need to take the responsibility for their own learning. In this case, Ivan needed to be aware of his preferred learning style and to decide how to adapt it to the online environment (McVay, 2002).

Kevin (Class A) was aware that he was a learner with visual and auditory learning styles. Whenever he had difficulty understanding written materials, he sought help from peers by communicating with them in person, on the phone, via email, or in Web Board. He also examined peers' assignments in an attempt to stay on track. Kevin's case has implications for course design. First, the instructor can help students facilitate

one another's learning by encouraging them to find learning partners. Second, whereas learning styles have been recognized as constituting one of the indicators of successful distance learning, it has been suggested that the visual learner performs better in a distance education class providing more visual cues, and the auditory learner in one employing audio technologies (Simonson et al., 2000). Therefore, the instructor can use graphics, video, or audio presentations of content to benefit students with visual and auditory learning styles. Third, online examples can be provided to assist students in the accomplishment of their learning tasks. In particular, the instructor can make previous students' work available online and encourage current students to post their assignments online for examination by their peers (Carr-Chellman & Duchastel, 2000).

The literature suggests that it is beneficial to make students aware of their learning styles in the orientation session (McVay, 2002). McVay's study showed that students who were aware of their learning style preferences experienced an enhanced ability to learn and an improved success rate in the completion of future courses. They were also more able to accommodate the different distance learning environments that they encountered in different classes.

Issues Related to Information Selection

Consistent with the literature (Fournier, 1996; Miller, 1960), the present study revealed that students adopted strategies to deal with voluminous information. Students who participated in this study fell into one of two groups according to their strategies for information selection. The students in one group spent more time and effort trying to absorb all of the information provided by the class. The students in the other group made

use of external means, including learning objectives and discussion questions, to help them narrow their focus on the course contents. Most students focused on information to fulfill course requirements and did not delve into extra resources unless time permitted. Frances (Class A) was the exception to this rule. Unlike the other students, when I interviewed Frances at the end of the semester she was still concerned that all course information was equally relevant and tried to read as much as possible.

Beishuizen et al. (1994) indicate that a lack of prior subject knowledge tends to hinder students' information selection skills. This was not the case for students in this study—including Doris, Grace (Class A), Ivan (Class B)—who lacked prior subject knowledge. These three students had extrinsic motivation, relying entirely on external means to regulate their learning and complete the course.

Frances' (Class A) particular characteristics—specifically, the combination of a lack of prior subject knowledge and a self-regulating style—may explain her experience. Frances tended to be a self-regulated learner who was usually intrinsically motivated, concerned with the relevance of a course to her intellectual development. Without sufficient prior subject knowledge, a self-regulated learner might delve too deeply into a topic of interest because no internal, knowledge-based criteria were available to separate relevant from irrelevant information (Beishuizen et al., 1994). The present study did not use any instrument to measure students' regulating styles; however, further research could be conducted to confirm this explanation.

The information presented above has some implications for online instructors. First, it is beneficial to make students aware of their own learning orientations and styles,

and to make suggestions to them about how to regulate their learning accordingly. Both self-regulating and externally regulated students who lack prior subject knowledge benefit from external means (Beishuizen et al., 1994). External means (such as learning objectives, overviews/outlines of the unit content, reviewing fundamental concepts/terminology) and cognitive supports (such as advance organizers) facilitate students' selection strategies. Meanwhile, external means (such as assignments and the instructor's feedback) help students evaluate their learning. Second, if a great deal of supplementary materials are offered, the instructor can reassure students by providing them with a list of the materials that are truly essential or by marking the essential material in some way, such as with an asterisk or a different color (McCormack & Jones, 1998).

Issues Related to Time Management

The literature notes that time is an important factor in the success of most distance learning students, particularly those individuals in mid-life who are busy with the demands of job and family (Moore & Kearsley, 1996). Moore and Kearsley suggest that for such individuals, job and family considerations often take priority over distance learning requirements. Carl (Class A) is an example of this phenomenon. He dropped out of the course due to the high demand of family responsibilities. To prevent drop out, Moore and Kearsley suggested that those distance students who are likely to experience job-, family-, or health-related problems need special counseling and guidance to help them identify these problems.

An interesting pattern emerged in the present study. Male students had a harder

time organizing their learning than did their female counterparts. For example, Alan (Class A), and Kevin (Class B) were employed full-time. At the end of the semester, they still struggled with the time issue, whereas their female equivalents who were also employed full-time (such as Frances and Grace in Class A) had learned to cope with this difficulty. Because the role of gender was not the focus of the present study, further research on this topic is needed to confirm this pattern.

Factors That Affect Online Students' Deep Processing

The present study revealed that IO tended not to influence students' deep processing, a finding that has not previously been supported in the literature (Angeli et al., 2003). This section addresses two factors affecting students' deep processing—the amount of mental effort that students put into study and the course structure—in an attempt to account for this contradictory finding.

Students' greater degree of invested mental effort on studying likely led them to achieve deep processing, although they perceived IO. Salomon's (1983) theory regarding the amount of invested mental effort has been discussed in the literature review. His theory tends to explain why the High IO students were able to process information at a deep level; individuals with a high level of perceived self-efficacy will invest a greater degree of mental effort when they perceive the demands of the medium or the task to be high. In this study, students' perceived demands of the medium and perceived self-efficacy were revealed in both interviews and questionnaires. The High IO students' perceived demands of CMC tended to be high because they perceived the difficulties of learning in this environment. As for the perceived self-efficacy of High IO students, the

results of the questionnaire were a first indication of the High IO students' level of ability and confidence regarding prior subject knowledge and the technical skills needed for participating in CMC. The results of the interviews then revealed their confidence in being able to learn in this environment, thus affirming their high self-efficacy. Consequently, those High IO students with high perceived self-efficacy would invest a greater degree of mental effort when they perceived the demands of CMC to be high. In other words, they expended a greater degree of mental effort on studying in order to achieve deep processing.

In contrast, students' less invested mental effort on studying likely led them to more surface processing, although they did not experience IO. Low IO students' perceived demands of CMC tended to be low, meaning that they found it easy to operate and learn in the online environment. As a consequence, when the demands of CMC were perceived to be low, those Low IO students with high perceived self-efficacy would not invest much mental effort into study. This may explain why some Low IO students tended to post superficial messages.

Salomon's (1983) theory also helps to explain the case of Bill in Class A (who was filtered out of this study): individuals with low perceived self-efficacy will invest much mental effort only if they perceive the demands of the medium or the task to be low. Bill perceived the demands of CMC to be high because he found the online environment very difficult. His self-efficacy was low because of his lack of prior subject knowledge and computer competence. Consequently, he would not put much effort into study. In fact, he did not meet the requirements for either the unit 1 or the unit 2

discussions.

When considering whether IO has an effect on online students' quality interaction, the course structure should also be taken into account. A previous study (Angeli et al., 2003) concluded that IO likely led to a lack of critical thinking; that study examined a fairly large class (146 undergraduate students) in which students were required to make a minimum of 5 postings during a 6-week-long computer conference. In contrast, the two sample classes examined in the present study had a total of fewer than 15 students each. Given the relatively small size of the classes, IO could be managed so that students could engage in quality learning. Winograd (2002) suggests that a good conference size is between 10 and 15 members, whereas a higher number of participants can make the conference difficult to follow.

Factors That Affect Online Students' Interaction

The present study revealed that IO may influence students' interactions, a finding that is supported in the literature (Vrasidas & McIsaac, 1999). This section examines the specific factors that affect students' interactions: students' degree of experience with CMC, their perceived demands of the amount of coursework, and the course structure.

In Class A of the present study, two variables which in some cases contributed to the students' perceptions of IO were their inexperience with CMC and their perceived demands of the amount of coursework. Those factors, in turn, tended to lead to fewer interactions.

The course structure of Class A tended to lead to more interactions, whereas the course structure of Class B led to fewer interactions. In Class A, the participation

requirement in online discussions, which accounted for 50% of the total grade, in addition to the specific criteria for assessing students' online contributions, led to more interactions among the students. In contrast, in Class B, the participation requirement in online discussions, which accounted for only 20% of the total grade, in addition to no specific criteria for assessing students' online contributions, might have led to fewer interactions among the students. As Bates (1995) suggested, explicit directions about relevant readings and the criteria used to assess contributions need to be given to students in order to improve the quality of their interaction. The instructor of Class B offered students the freedom to discuss openly any questions or reactions arising from that unit. As a consequence, this class had a more open online discussion format than that of Class A. In addition, Class B, in contrast to Class A, did not employ specific criteria for assessing students' online contributions. As a result, students in Class B noted that Web Board discussions usually reflected peers' general reactions and were time-consuming to browse. The differences in how online discussions were conducted may explain the differences in the quantity and quality of student interactions in these two classes.

The Importance of Metacognitive Strategies to Online Students

Previous studies of CMC in education (Burge, 1994; Eastmond, 1994; Harasim, 1987) revealed some coping strategies used by students to deal with IO. These coping strategies include reading and commenting selectively, filtering out unwanted information and keeping what appears to be useful information, scanning on-screen messages in one attention period, encouraging peers to write shorter messages and so

forth. The present study, on the other hand, has identified strategies used by students for avoiding or managing perceptions of IO in order to engage in quality learning. It suggests relatively comprehensive strategies that can be employed profitably both by students and by online educators.

The present study revealed the importance of metacogntive awareness in achieving both quality and quantity level of interaction in online discussions. Students who were more likely to engage in quality learning in online discussions were those who were more aware of their learning difficulties and who, in turn, exerted more time and effort and adopted different strategies (either coping or meaningful learning strategies, depending on their available internal and external resources) to achieve their learning goals. As a means of coping with the voluminous information, some students with time constraints regulated their learning wisely by adopting selection strategies in order to fulfill the course requirements. They made best use of external means offered by the course instructions to form selection criteria in order to distinguish between relevant and irrelevant information. These students then focused exclusively on the selected information for deep processing.

The strategies used by those students demonstrated their metacognitive awareness of the importance of monitoring, regulating, and evaluating their learning in order to complete the course. Whereas the evidence regarding cognitive strategies' effectiveness for learning is inconclusive, research findings concerning the relationship of metacognition to academic performance are more consistent (Biggs, 1988b; Everson & Tobias, 1998; Kurtz & Weinert, 1989). The results of this study tend to support Biggs'

claims that metacognitive strategies lead to improvements in academic performance; in other words, for success in learning "students need to be aware of their motives, of task demands, and of their own cognitive resources, and to exert control over the strategies appropriate for handling the task" (p. 127).

Implications for Course Design

This study has several implications for course design: (a) readiness for online courses, (b) design issues for the course website, and (c) design issues for online discussions. These implications would help minimize students' IO in an online environment.

Readiness for Online Courses

Readiness for online courses is essential for removing students' cognitive demands from learner-interface interaction (Hillman et al., 1994), as well as ensuring their familiarity with course structure and expectations. The following suggestions will assist online educators in ensuring students' readiness:

1. An orientation should be arranged as early as possible for introducing syllabi, CMC tasks, and technology training, and solving any connection problems (Murphy & Cifuentes, 2001). Most students in the present study indicated that the orientation sessions were an immense help in understanding the course requirements and the instructor's expectations, as well as offering an opportunity to resolve any technical problems.

2. Ivan in Class B suggested that the instructor should lower the course workload at the beginning because students need time to overcome difficulties associated with the CMC environment.
3. It is important for the instructor to provide students with guidance in time management at the beginning. First, most distance students, particularly those who have demands of job or family responsibilities, need guidance to help them organize learning. Second, first-time online students need guidance in time management to adjust themselves to the differences of the online learning from the format of regular once-a-week on-site classroom learning. Finally, online instructions that are designed and implemented from a constructivist perspective rely heavily on students to manage their learning tasks and engage in interaction with peers and content (Perkins, 1991; Vrasidas, 2000). Vrasidas suggested that the teacher should coach the students to manage their tasks and help them take control of their learning.

Design Issues for the Course Website

This study suggests ways that the design of the course website might help manage IO:

1. Both self-regulating and externally regulated students lacking prior subject knowledge benefit from external means (Beishuizen et al., 1994). External means include learning objectives, overviews/outlines of the unit content, reviewing fundamental concepts/terminology and cognitive supports (such as advance organizers) facilitate their selection strategies.

2. External means such as assignments and the instructor's feedback help students evaluate their learning. The instructor can make previous students' work available online and encourage current students to post their assignments online for examination by their peers (Carr-Chellman & Duchastel, 2000).
3. Varied learning style preferences of students, particularly visual and auditory learning styles, should not be ignored in the text-based learning environment. The instructor can use a variety of presentations of content to benefit different learning styles (Fournier, 1996).
4. The instructor may offer a variety of supplementary materials to meet the needs of students from different background. The instructor should reassure students by providing them with a list of the materials that are truly essential or by marking the essential material in some way, such as with an asterisk, a different color, or different level of priorities (McCormack & Jones, 1998).
5. To avoid navigation difficulties, most students in this study indicated that they preferred a linear as opposed to a non-linear style for browsing web pages. In addition, a page containing more than three levels easily confused students. When a website contains a lot of information, a separate place for important information is needed. For example, students in Class A suggested a place on the course website for information regarding FirstClass (such as technical knowledge, instructions about purposes of different conferences and how to do tasks in FirstClass, and a sitemap of FirstClass). A design suggestion is to provide technical information in an obvious

place that draws students' attention rather than one that requires them to dig through all the pages to get the information.

6. The instructor can provide timely feedback or guidance whenever students have problems related to the course website, such as course content, requirements, and technologies. Technological problems create unnecessary anxiety for students (Fournier, 1996) and, in turn, distract their attention from content learning (Harasim, 1986). Instructor's feedback not only helps students to validate their learning (Fournier), but also encourages students' engagement in learning (Vrasidas & McIsaac, 1999).

Design Issues for Online Discussions

This study also suggests ways that the design of online discussions might help manage IO:

1. Several steps can be taken to avoid fragmentary information and confusion (Salmon, 2000; Winograd, 2002). First, the instructor or discussion facilitators can remind students how to navigate messages effectively when discussions become very active. Second, the instructor or discussion facilitators can weave and summarize messages at the appropriate time. Third, the instructor or discussion facilitators can reorient the discussions when they stray off-topic. Finally, the instructor or discussion facilitators can provide immediate guidance to students who are not on the right track.
2. The instructor or discussion facilitators can offer guidance and instructions on how to navigate messages effectively to minimize navigation difficulties. For example, FirstClass offers functions like selecting, sorting, and summarizing messages for

navigation. Additionally, a deep level of non-linear style is not preferred. Most students using FirstClass responded that when the levels of conferences went beyond three, they became easily confused.

3. The instructor should emphasize the necessity for discussion facilitators to provide timely feedback and encourage their peers' participation to promote online interaction (Vrasidas & McIsaac, 1999).

Recommendations for Future Research

This study has provided information about graduate students learning in a CMC environment in an education program at a large university during one semester. The data gathered only begin to provide a picture of the difficulties that contribute to students' perceptions of IO, how those difficulties possibly influence their levels of information processing and interaction with others in online discussions, and students' strategies for avoiding or managing those difficulties in order to engage in quality learning. Further research will help provide a better understanding of the phenomenon of IO in educational CMC and offer better suggestions for course design and learning strategies to manage this problem. The following are recommendations for future investigations:

1. Future research could include an instrument measuring students' amount of invested mental effort for triangulation. The amount of invested mental effort is difficult to measure. The instrument used by Salomon (1984) did not measure the amount of mental effort children actually invest in media (i.e., television and books), but assessed the mental effort as reported by children themselves. However, Kunkle (1981) had used the same instrument to measure university students' reported

invested mental effort. In the research done so far, this instrument has produced results that match the theoretical predictions (Beentjes, 1989). Therefore, Salomon's instrument could be modified for use in the medium of CMC.

2. Future research could include an instrument measuring students' regulating styles for triangulation. Beishuizen et al. (1994), when observing students' study behaviors in a hypertext system, used the Inventory of Learning Styles developed by Vermunt and Van Rijswijk (1987) to measure their regulating styles. This instrument is recommended because the learning styles measured not only included cognitive strategies, but also metacognitive and affective strategies (Beishuizen et al.).
3. Future research could increase the sample size to confirm the speculations regarding the relationship between students' quality interaction in computer conferencing and factors such as students' regulating styles, students' amount of invested mental effort, and the structure of the course.
4. It was beyond the scope of the current study to examine facilitators' conference moderating skills; however it would have been useful to do so. Other researchers (Angeli et al., 2003; Bates, 1995; Burge, 1994; Salmon, 2000) have stressed the importance of moderating strategies in promoting quality interaction.
5. This study focused on a specific group of graduate students majoring in subjects in the field of education that were reading and writing intensive. Similar studies could be carried out with different target learners (such as undergraduate students), with different learners majoring in different kinds of subject matter, or with students learning in different domains (such as in scientific and technological fields).

6. This study examined a particular technology format (text-based CMC). A similar study could be conducted in online classes incorporating different technologies such as audio, video, or multimedia technologies. Investigations into learning via more advanced educational CMC would focus on how technologies can help learners manage the problem of IO effectively.

The issue of promoting quality communication in CMC appears to be a complex one (Angeli et al., 2003). The results of examinations of quality communication in computer conferencing are not consistent. Whereas some studies (Gunawardena et al., 1997; Hara et al., 2000; Newman et al., 1995) have demonstrated that CMC encourages quality discourse, others (Angeli et al.) have come to the opposite conclusion (i.e., students' online discourse showed little evidence of critical thinking). These previous studies all focused on examining conferencing messages only, but paid little attention to variables inherent in students and learning situations.

In contrast to previous studies, the present study employed a mixed-method design to explore issues related to students' perceptions of IO. It not only examined students' quality interaction in online discussions in a quantitative manner, but also investigated students' learning difficulties and their strategies for dealing with those difficulties by using a qualitative approach. The findings of this study suggest that in order to promote quality interaction in computer conferencing, not only the medium, instructional methods, and moderating strategies, but also students' personal characteristics, amount of invested mental effort, metacognitive awareness, and the course structure should be considered.

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APPENDIX A

IRB APPROVAL LETTER

TEXAS A&M UNIVERSITY
Office of the Vice President for Research
1112 TAMU • College Station, Texas 77843-1112
(979) 845-8585
FAX (979) 845-1855

November 20, 2001

MEMORANDUM

TO: Chun-Ying Chen
Department of Educational Psychology
MS 4225

SUBJECT: Approval of IRB Protocol Entitled "Learners' Strategies to Deal with Information Overload in Computer-Mediated Communication"
22001-343E

The above referenced protocol has been:

__X__ Approved November 20, 2001 – November 19, 2002
____ Conditionally Approved (see remarks below)
____ Disapproved (see remarks below)
____ Tabled (see remarks below)

by the Institutional Review Board - Human Subjects in Research.

The study has been approved for one year. Your protocol must be re-approved each year. If you desire to make any changes in your research protocol, the changes must be approved by the IRB before they are initiated. Any adverse reactions or events must be reported immediately to the Board.

E. Murl Bailey, Chair
Institutional Review Board -
Human Subjects in Research

APPENDIX B

AUDIO TAPE RELEASE FORM

I voluntarily agree to be audio taped for the interview(s) being conducted by Chun-Ying Chen during spring semester 2002. I understand that the tapes will be used only for data analysis related to her Ph.D. study, Learners' Strategies to Deal with Information Overload in Computer-Mediated Communication and that only the researcher, Chun-Ying Chen, will have access to the tapes. To ensure confidentiality, these tapes will be identified by numbers. The tapes will be kept until the data analysis is completed, and they will be stored at the researcher's residence. After completion of the data analysis, the tapes will be erased.

_____	_____	_____
Participant's Name	Participant's Signature	Date

_____	_____
Chun-Ying Chen	Date

REFUSAL TO BE TAPED

I do not agree to be audio taped during the interview(s) conducted by Chun-Ying Chen. I understand I will not receive penalty of any kind by such a refusal. By refusing to be audio taped, I understand that I may continue to participate in the study.

_____	_____	_____
Participant's Name	Participant's Signature	Date

_____	_____
Chun-Ying Chen	Date

APPENDIX C

BACKGROUND QUESTIONNAIRE

Thank you for taking the time to participate in my dissertation study. The results of this questionnaire will be used to help explore students' learning experiences in online courses, and identify their online learning strategies. Your responses are very important to the study and your participation is greatly appreciated.
Chun-Ying Chen

Date _____ Participant Code: _____ (do not fill in here)

Part I - Demographic Data

Name _____ Gender □ male □ female

Email Address _____

Mail Address _____

_____

Home Phone _____ Work Phone _____

Your standing □ graduate/master □ graduate/doctoral

Your major and department _____

Total number of hours enrolled in this semester _____

Are you employed? □ Yes □ No

If yes, number of hours per week _____

Your occupation _____

Information about further participation
This Background Questionnaire consists of five parts: a) demographic data (the above), b) prior subject knowledge, c) English reading and writing proficiency, d) online course experience, and e) technology use experience. You will complete this questionnaire today. If you agree to and are selected to participate further in this study, you will be asked to complete the following: 1) the first round of interviews conducted during the fourth or fifth week of the semester, and 2) the second round of interviews conducted near the end of the semester. Each interview will take approximately 45-90 minutes. The interviews will be conducted by e-mail, online chat, telephone, or face-to-face – depending on your convenience – with the first priority being face-to-face. Several options are offered to ensure saturation of information, because your responses are valuable and important contributions to this study. After this study is done, you will receive the summarized findings of the study by e-mail if you continue to participate. The final report should be finished by May 2003. I hope the results - learning strategies for online course - will benefit you. Thank you again for your participation.

I would like to participate further in your study. □ Yes □ No

_____ _____
Participant's Signature Date

Part II – Prior Subject Knowledge

1. Your undergraduate major _____

2. Have you previously taken any graduate level classes related with the subject content of this class? If yes, what classes?

Part III – English Reading and Writing Proficiency

1. Is English your first language? □ Yes □ No

   If English is not your first language, what is your first language? _____

Please check that reflects your current English reading and writing proficiency.

2. How is your reading in English?

   □ Poor □ Fair □ Good □ Fluent

3. How is your writing in English?

   □ Poor □ Fair □ Good □ Fluent

Part IV - Online Course Experience

Online courses have been taken:

Complete the following sentence by circling the correct number.

I have taken _____ online course(s) previously.

0 1 2 3 4+

List the names of the course(s), where and when taken (e.g. TAMU, Fall 2001), and course delivery software (e.g. FirstClass, WebCT, TopClass, Blackboard, … etc.).

	Course Name	Where did you take this class	Semester / Year	Course Delivery Software
1				
2				
3				
4				
5				

Part V - Technology Use Experience

Please respond to each of the following competencies. Check all statements that reflect your current skills.

1. Basic Computer Operation

- □ Level 1-- I can use the computer to run a few specific, pre-loaded programs.
- □ Level 2-- I can set up my computer, load software, print, and use most of the operating system tools like the scrapbook, clock, notepad, find command, and trash can.
- □ Level 3-- I can customize my computer and peripheral devices like zip drives, backup drives, and sound system.
- □ Level 4-- I feel confident enough to train others in setting up and using a computer.

2. File Management

- □ Level 1-- I do not save any documents I create using the computer.
- □ Level 2-- I save documents I have created, but I cannot choose where they are saved.
- □ Level 3-- I have a filing system for organizing my files and can locate files quickly and reliably.
- □ Level 4-- I regularly run a disc-optimizer on my hard drive and use a back-up program on a regular basis.

3. File Transfer

- □ Level 1-- I do not know how to transfer files electronically.
- □ Level 2-- I have occasionally transferred files, but I do not understand the process well enough to feel confident about it.
- □ Level 3-- I can transfer files easily and feel confident with my ability to do so using either Fetch on a Mac or FTP on a PC.
- □ Level 4-- I have taught others to transfer files using Fetch on a Mac and/or FTP on a PC and to compress and uncompress files using either ZIP or STUFFIT.

4. E-mail Use

- □ Level 1-- I do not use electronic mail, nor can I identify any uses or features they might have which would benefit the way I work.
- □ Level 2-- I send occasional requests for information and messages using e-mail--mostly to friends, family, and colleagues.
- □ Level 3-- I use e-mail on a regular basis and/or participate in online e-mail discussions via listservs.

- Level 4-- I involve others in using e-mail and listservs to communicate with others regardless of location.

5. Web Browser Operation & Internet

- □ Level 1-- I do not use the Web, nor can I identify any of its uses or features that would benefit the way I work.
- □ Level 2-- I use Web searching software and other Internet resources to locate important sources of information.
- □ Level 3-- I create my own HTML pages and lists of linked resources.
- □ Level 4-- I have taught others to create their own HTML pages and lists of linked resources.

6. Computer Conferencing

- □ Level 1-- I do not use computer conferences, nor can I identify any of their uses or features that would benefit the way I work.
- □ Level 2-- I have used computer conferences and know what they can do, such as complete assignments and exchange information with peers.
- □ Level 3-- I have moderated computer conferences as a teaching and/or communication tool.
- □ Level 4-- I have taught others to use computer conferences.

7. Information Searching

- □ Level 1-- I am unlikely to seek information when it is in electronic formats.
- □ Level 2-- I can conduct simple searches with the electronic encyclopedia and library software for major topics.
- □ Level 3-- I have learned how to use a variety of search strategies on several information programs, including the use of tools, like Infoseek, Excite, Lycos and Web Crawler.
- □ Level 4-- I have incorporated logical search strategies into my work with others, showing them the power of such searches via the Internet.

This survey is adapted from the Background and Experience of Developers' questionnaire developed by Tina Harvell for use in her dissertation study, "Costs and Benefits of Incorporating Web-based Material into the Traditional Classroom." The Background and Experience of Developers' questionnaire included information taken from the Bellingham Public Schools Technology Survey (http://www.bham.wednet.edu/tcomp.htm) and the Mankato Survey (wwwshs1.bham.wednet.edu/about/mankatst.htm).

APPENDIX D

INTERVIEW PROTOCOL I

Participant Code: _____ Time for Interview: 45-90 minutes

The interviews will be conducted near the beginning of the semester, during the fourth or fifth week.

Discuss the online course experience the interviewees are taking now:

1. Tell me about your learning experiences in FirstClass or Web Board.

   - How do those information processing issues influence your learning?

   Probe:

   Quantity of Information

   a) How do you feel about the numbers of messages posted in FirstClass or Web Board?

   Quality of Information

   a) Do you ever encounter messages with complex grammatical structure?
   b) Do you ever encounter messages that seem ambiguous? For example, in this sentence "Mary told Sue that she had won the beauty contest," it is not clear who won the beauty contest – Mary or Sue.
   c) Do you ever encounter messages that seem trivial?
   d) Do you ever encounter messages that seem repetitive? For example, someone may make the same or similar comments as others.

   Medium Interface

   a) How do you feel about the structure of how messages are arranged in FirstClass or Web Board?
   b) How do you feel about the multiple conference spaces in FirstClass?
   c) Do you ever feel information is fragmental? What causes it, and how do you deal with it?

2. Tell me about your learning experiences from the course website.

   - How do those information processing issues influence your learning?

   Probe:

   Quantity of Information

   a) How do you feel about the quantity of information on the course website?

   Quality of Information

   a) How do you feel about the structure of how information is arranged on the course website?

   Medium Interface

   a) How do you feel about the number of links on the course website?
   b) Do you ever feel information is fragmental? What causes it, and how do you deal with it?

Discuss other online course experience (first online course, second online course, and so forth) they have taken: (use the question 1 and 2 as the guide)

3. Most online learners say they spend more time learning online than learning in the traditional classes. Do you also feel that way? Why, or why not?

APPENDIX E

INTERVIEW PROTOCOL II

Participant Code: _____ Time for Interview: 45-90 minutes

The interviews will be conducted near the end of the semester.

The first round of interviews conducted near the beginning of the semester revealed some information processing issues. I compiled those issues and would like to talk with you about them, and explore your experiences in dealing with those issues.

For each issue,

1. Tell me your experiences in dealing with the issue.
   - How did you deal with it, or what is your suggestion for dealing with it?
   - How did you figure out how to deal with it?
2. How have any particular aspects of this online class helped you deal with the issue? The particular aspects could be the instructor, the fellow students, the instruction, etc.

Note. Several issues may contain sub-questions such as the issue 1, 2, 3, 4, 5, 6, and 7. For each issue containing sub-question(s), you may combine your responses to the sub-question(s) with your responses to the above two primary questions.

The followings are the compiled 16 issues:

Learner Readiness

1. When you are or were a online class novice, there are a lot of information needed to tap at the beginning, such as understanding the syllabus and how this course is organized, setting up the connection, learning how to use the software and how to take this kind of class, etc. How did you adapt yourself to this online environment in order to learn?
2. You had the frustrations with FirstClass early on, such as connection problem, not familiar with this software, trying to decide what icon meant what, etc. How did you become proficient using FirstClass later on?

Quantity of Information

3. How do you select relevant or important information to your learning from the resources provided by the instructor? How do you organize those materials? How do you read through each material?
4. The amount of messages is sometimes too many in FirstClass or Web Board. How do you keep up with the discussions? How do you navigate through those threaded messages?
5. All information in an online course is in written form rather than spoken form and you have to take learning upon yourself. In this situation, how do you make sense of new information, and how do you connect new information to prior knowledge while you are reading an article or participating in online discussions?
6. There are ongoing learning activities due on varied days of the week. How do you organize yourself to manage those learning activities?
7. From your experience, how did you schedule your time effectively to learn in this kind of online class?

Quality of Information

8. You encountered difficult learning materials.
9. You encountered off-topic discussions.
10. You encountered ambiguous and inconsistent guidelines of how the course is run.
11. You felt that sometimes online discussion messages in FirstClass or Web Board are repetitive.

Medium Interface

12. You encountered complex organization of a website and that resulted in your difficulties of locating information you need.
13. You encountered difficulties with navigating discussion messages in FirstClass or Web Board.
14. You felt confused with the multiple conference spaces in FirstClass.
15. You felt the information is fragmental while navigating a Web.
16. You felt the information is fragmental while navigating discussion messages in FirstClass or Web Board.

APPENDIX F

SCHEDULING AND DURATION OF INTERVIEWS

The First Round of Interviews

Class	Student	Date	Interview Approach	Duration
EDTC Class	Alan	February 12	Online Chat	45 min/9:40-10:25pm
	Bill	February 11	In Person	20 min/2:40-3:00pm
	Carl	February 11	In Person	30 min/8:05-8:35pm
	Doris	February 14	In Person	45 min/11:25-12:10pm
	Eric	February 11	In Person	35 min/1:25-2:00pm
	Frances	February 13	Online Chat	37 min/7:40-8:17pm
	Grace	February 13	Online Chat	35 min/10:00-10:35pm
EDAD Class	Helen	February 13	In Person	75 min/2:45-4:00pm
	Ivan	February 06	In Person	60 min/4:00-5:00pm
	Jack	February 11	In Person	65 min/6:35-7:40pm
	Kevin	February 14	In Person	55 min/10:20-11:15am
	Lily	February 06	In Person	60 min/11:20-12:20pm

The Second Round of Interviews

Class	Student	Date	Interview Approach	Duration
EDTC Class	Alan	April 02	E-mail	N/A
	Bill	April 04	In Person	65 min/4:20-5:25pm
	Carl	April 08	In Person	44 min/7:25-8:09pm
	Doris	April 04	In Person	56 min/1:40-2:36pm
	Eric	April 05	In Person	60 min/1:10-2:10pm
	Frances	April 02	E-mail	N/A
	Grace	April 03	E-mail	N/A
EDAD Class	Helen	April 15	In Person	65 min/3:40-4:45pm
	Ivan	April 10	In Person	20 min/2:50-3:10pm
	Jack	April 13	In Person	60 min/3:30-4:30pm
	Kevin	April 09	In Person	60 min/10:20-11:20am
	Lily	April 01	In Person	55 min/2:00-2:55pm

Note. min = minutes; N/A = not available.
Grand total of all interviews: 1,047 minutes = 17 hours 45 minutes.

VITA

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